THURSDAY, JANUARY 9, 1890.

THE ZOOLOGICAL RESULTS OF THE "CHALLENGER" EXPEDITION.

Report on the Scientific Results of the Voyage of H.M.S. "Challenger" during the Years 1873-76, *under the command of Captain George S. Nares, R.N., F.R.S., and the late Captain Frank T. Thomson, R.N.* Prepared under the superintendence of the late Sir C. Wyville Thomson, Knt., F.R.S., &c., Director of the Civilian Staff on board, and now of John Murray, LL.D., Ph.D., &c., one of the Naturalists of the Expedition. Zoology—Vols. XXXI. and XXXII. (Published by Order of Her Majesty's Government. London: Printed for Her Majesty's Stationery Office, and sold by Eyre and Spottiswoode, 1889.)

WITH these recently published volumes, the series of Reports on the zoological results of the *Challenger* Expedition, comes to a close. Volume XXXI. contains three Reports, the first of which is on the "Alcyonaria," by Profs. E. Perceval Wright and Th. Studer. It would appear that on the first distribution of the zoological treasures of the Expedition, the Alcyonaria were given to Prof. von Kölliker to describe, and the first part of his Report on the Pennatulidæ, forms the Second Report published in 1880. From a note of the editor, we learn that Prof. Kölliker being unwilling to undertake the remainder of the group, the fixed forms were committed to Dr. E. P. Wright for description. After the appearance of the "Narrative of the Expedition" in which a few of the more remarkable of the new species were described by this author, Prof. Studer consented to join Dr. Wright in preparing the Report, and all the details were worked out in unison.

The Report opens with a brief introduction, in which an attempt is made to present a more or less complete list of the orders, families, and genera, of the recent Alcyonaria; short diagnoses and references to the bibliography are given. While this introduction might with advantage have been greatly expanded, yet we think its value will be appreciated by all those working at this group. This is followed by the description of the genera and species in the *Challenger* collection. In the earlier pages an attempt has been made to include brief notices of all the known forms, but it was soon found that this would occupy too much space, as the forms from large portions of the Indian Ocean and the very rich Alcyonarian fauna of the western shores of North America were not represented in the collection.

One hundred and eighty-nine species are described as found during the voyage of the *Challenger* and of this number no less than one hundred and thirty-three are described as new. Of the more interesting of these, the following may be mentioned, *Callozostron mirabilis*, a most extraordinary species taken in the Antarctic Sea, in the most southerly dredging made during the voyage. While there can be no doubt as to its affinities yet this form presents many puzzling features. Another remarkable species from the Fiji's, *Calypterinus allmani*, although it has a rigid axis, in the arrangement of its polyps shows some relationship to the previously mentioned species A great number of new species are added to a genus quite recently described by Verrill, and which is made the type of the family Dasygorgidæ. The new genus Acanthoisis, which is nearly related to the well known genus Isis, exhibits an unique condition of its axis, which consists of alternate horny and calcareous joints, the latter being very beautifully grooved and spined. *Keroeides koreni*, with a sclerogorgic axis, from Japan, is also a curious species, with massive spicules.

Under the heading of "Geographical Distribution," a brief history is given of the distribution of the species of most of the well established genera; while this subject is necessarily very incomplete, yet it would seem as if the West Indian Islands, the Californian shores of America, the Australian seas and especially those of Japan were the chief centres of the group. But it cannot be overlooked that the record is very imperfect and that the recent researches of Danielssen have proved that immense numbers of species exist in the seas of Norway.

This Report extends to 386 pages and is illustrated by 49 lithographic plates, the figures in which have been drawn by Mr. George West, Jun., and Mr. Armbruster of Berne.

The second Report is by Dr. Günther, on the pelagic fishes, and comprises an account of the specimens which were obtained in the open ocean by means, chiefly, of the surface net.

The specimens were as numerous as those of either the shore or deep-sea fishes, described in the author's first and second Reports on the *Challenger* fishes, and by far the greater number were of small size; some, indeed, had been taken at so early a stage in their development as to make it impossible to refer them to their family or even order. The pelagic fish fauna, as defined by the author, consists, first, of the truly pelagic fish—those which habitually live on the surface of the ocean, accidentally and rarely approaching the shore; the majority breed in the open sea and pass through all their phases of growth without coming into the vicinity of land; numerous representatives of these were in the collections. Secondly, there are a number of fishes inhabiting the depth of the ocean, from a hundred fathoms downwards, which seem periodically to ascend to the surface, possibly in connection with their propagation; most of these are found at the surface, only during the early stages of their growth, but they connect the truly surface fishes with the deep-sea fishes, and were fairly well represented in the collection. Thirdly, the pelagic fauna receives a very considerable contingent from the littoral fauna; some shore fishes, when in a young state, are, while floating on the surface, driven to sea to great distances by currents and winds; many such immature forms were found. And, lastly, fully developed specimens of littoral species sometimes stray or are accidentally driven out to the open sea, and several such were in the collection.

Sixty-seven species are indicated, and several new genera and species are described. A new species of Branchiostoma is described from the Pacific; it was either from the surface or from a depth of 1000 fathoms; the perfect condition of its delicate fin-fringe seemed to militate against the latter idea, and yet it would be even more extraordinary to find a lancelet living at the surface

of the open sea. This Report extends to 47 pages, and has six plates.

The third Report is by Arthur W. Waters, and is entitled a "Supplementary Report on the Polyzoa.' From every point of view we regret that these "notes the time for the preparation of which has been limited by Mr. Murray," have been published as part of the present series of Reports.

If the Reports on the *Challenger* Polyzoa by the late George Busk, which form Parts XXX. and L. of the zoological series, had been defective, say, for example, that a number of new or rare species had escaped description, then it would have been useful and perhaps excusable to have had a supplemental Report issued, noting such; but out of the 41 pages of which this Supplementary Report consists, not more than one and a half are devoted to the record of the three new species described, while the rest is simply a series of criticisms on the late Mr. Busk's work.

The very heading of the Report contains an implied piece of criticism, "The term Polyzoa is used for sake of uniformity." Into the argument *pro* and *con* for the use, of this term it is not needful for us here to enter, but remembering what Mr. Busk had written to justify its use, this uncalled-for remark might have been omitted. We read :—

"Shortly after the death of Mr. George Busk, who prepared the Report on the *Challenger* Polyzoa, I had, through the kindness of his daughter, Miss Busk, an opportunity of examining some of the duplicate specimens, and I desire to thank her for sending me those which, from published criticism, were most interesting to me. I have also to thank Mr. John Murray, the director of the *Challenger* publications, for allowing me to examine the whole of the duplicate material in Edinburgh. I communicated to Mr. Murray some valuable results arising from an examination of sections of the *Challenger* specimens prepared by a method similar to that employed in the examination of fossil Polyzoa, and at his request I have drawn up the following supplementary notes on the *Challenger* species."

We have been careful to quote the author's own account of his work, which would have formed an interesting communication to any of our scientific Societies, but which seems to us to be quite out of place where it is now published. There is probably not one of the eighty-two Reports published on the zoological results of the *Challenger* Expedition that could not be added to and emended, and no one would wish that they should escape every just criticism, but this is quite a different thing from employing the funds placed by the Treasury for the publication of these Reports on the printing and illustrating of critical notes on the already published ones. This supplementary Report is illustrated by three plates from drawings of the author.

In the editorial notes to Vol. XXXII. we are told :—

"This volume concludes the zoological series of Reports on the scientific results of the Expedition, with the possible exception of a few supplementary notes to some of the memoirs and Prof. Huxley's Report on the genus Spirula, which may appear as an appendix to the concluding summary volume."

We must content ourselves with protesting against the publication of any further "supplementary notes" on the Reports unless these are contributed by the several authors thereof. As to a "concluding summary volume," opinions may differ as to the advisability of publishing a summary of the thirty-two volumes in the same series as the original volumes. For the scientific worker such a summary would be quite useless, for any such would have recourse to the full details. For the general reader, anxious to know something of the facts stored away, beyond his reach, in these many ponderous volumes, a summary would no doubt be of interest, and, if fairly well executed, of value, but the size and cost of a volume like those already published in this series would place such far beyond the buying powers of most people, and to us it would seem a waste of public money to undertake so unnecessary a labour. If, indeed, the Treasury would publish, in a convenient handy volume, a carefully prepared sketch of the cruise of the *Challenger*, with a few chapters added giving a summary of the additions to biological knowledge, which were the immediate results of the Expedition, such a volume would be acceptable to the general public, and would let them know more than they at present do of the most important voyage of discovery of this century.

The first Report in Volume XXXII. is on the Antipatharia by George Brook, and we believe it to be one of the most praiseworthy of all the Reports; the time at the disposal of the author was of necessity very short, and perhaps no group of marine animals had been so little attended to. Our Museums no doubt possessed numerous specimens, but these being in the great majority of cases, only the dried skeletons, presented little upon which to work, there were therefore many and serious drawbacks to a determination of the species or to a knowledge of their anatomy. In spite of all this Mr. Brook has succeeded in making this Report an excellent contribution to our knowledge of the classification, distribution, and anatomy of the group. There was one fortunate circumstance about the *Challenger* specimens, most of them had the polyps well preserved, so that their structure could be fairly well made out. Making the most of the material at his disposal, the author has attempted a partial revision of the group, and has placed the classification for the first time on a natural basis. The study of the fine collections made by Pourtales and during the voyages of the *Blake*, would have greatly assisted Mr. Brook's labours, but as in the case of the Alcyonaria, the specimens were not available.

Nearly all the forms collected by the *Challenger* were new, which is to be largely accounted for, by the fact that almost all the collections were made in localities from which no Antipatharia had been previously recorded. The collection is remarkably deficient in littoral forms, but a number of species are now for the first time described from great depths. In this monograph not only are all the *Challenger* species described but a number of new species in the British Museum are also described, so that the Report forms quite a monograph of the group.

The Report opens with a bibliography, not a very extensive one, and one which up to the time of Pallas, possesses little interest. Botanists like Bauhin, Tournefort, and Breynius are among the pre-Linnæan writers who refer to these corals, and it is worthy of note that the last mentioned of these authors, describes and gives an

excellent figure of a species of Antipathes, in his "Prodomus fasciculi rariorum plantarum anno 1679 in hortis celeberrimis Hollandiæ, etc., observatarum." He calls it *Abies maritima*, and mentions it as a fossil plant; thus beginning his Prodomus with a form which was not a plant, and which certainly never grew in any of the Dutch gardens. After the bibliography there is a critical review of the literature; it is pleasing to find the author doing justice to Esper's "beautiful work 'Die Pflanzenthiere,'" and without wishing to enter on any technical criticism in a general notice like this, we may mention, in reference to a remark that "Esper does not describe *Antipathes ericoides*, but gives a figure of it," that in the second volume of his work, p. 150, he tells us that the name *Antipathes myriophylla* should replace the name of *Antipathes ericoides* engraved on the plate, and having a delamarck's[1] copy of the "Fortsetzungen der Pflanzenthiere" open before us, we may add that nearly all the references to Part ii. of this work in Mr. Brook's Report should be to Part i. Part ii. contains only 48 pages, and *Antipathes virgata*, Esper, is the only species of the genus described in it. In justice to Esper it may be also mentioned that he corrects his mistake of describing a decorticated gorgonid as *A. flabellum* (*vide* "Pflanzenth. forts.," ii. Th. p. 33).

The general morphology is next treated of, a general outline of the structure of the various genera, more especially with regard to the forms of the zooids and the number of and relative development of the mesenteries; this is the first detailed outline of the kind yet published on the morphology of the group, and it is illustrated by woodcuts. The classification and description of the genera and species follow; then notes on the geographical and bathymetrical distribution. Four species were taken at depths of between 2000 and 3000 fathoms.

A chapter on the anatomy concludes the Report, but we must content ourselves with quoting only the last few words of this most valuable contribution:—

"The Antipathinæ approach the Cerianthidæ more closely than the Hexactiniæ in structure, particularly in the following points: the arrangement of the mesenteries; the relatively thin mesoglœa, which is entirely devoid of stellate connective tissue cells; the presence of an ectodermal muscular layer in the stomodæum and body wall; and the rudimentary condition of the musculature of the mesenteries."

This Report extends to 222 pages, and has an atlas of 15 plates.

The second Report in this volume is by Prof. Th. Studer, M.D. Bern, being a "Supplementary Report on the Alcyonaria." We quote the short preface:—

"After the main Report on the *Challenger* Alcyonaria was in the press, several further specimens were found. These were in part new species, of which however, it was no longer possible to insert a description in the text. I am under great obligations to Dr. John Murray, the editor of the *Challenger* Reports, for allowing me to publish in the form of a supplement an account of these new species with the necessary illustrations. At the same time I have seized the opportunity to insert further illustrations of such forms as Dr. Wright and myself had only been able to describe in the Report, as *Telesto trichostemma* and *Siphonogorgia kollikeri*. This supplement extends the list of the *Challenger* collection by three new species of the genus Siphonogorgia, three Muriceidæ, an Indian representative of the genus Bebryce (which before had been known only from the Mediterranean), and one of the Plexauridæ."

[1] So Lamarck has written his name on the title-pages.

It seems surprising that as a matter of courtesy, quite apart from other considerations, either the editor of these Reports or the author of this supplementary one, could have brought out this 81st Part of the *Challenger* Reports, without any communication with or participation therein, by Prof. Wright, to whom the preparation of the Report of the fixed Alcyonaria was originally committed.

With personal matters the reader has no right to be troubled, but he may well inquire why, when the Report itself was published in 1889 as the joint work of two Reporters, who narrate in their preface how pleasantly they worked in unison, there should appear in the same year this supplementary Report, written by but one of the two, and why he should acknowledge "his great obligations to Dr. Murray for enabling him to describe seven new species, under his own name," which had been found not by himself, but had been transmitted to him by his co-reporter as new forms early in 1888. The dates of the reception of the manuscript of this supplement prove that it could have been easily added to the appendix to the Report.

This supplementary Report adds eight, not seven as stated in the preface as quoted above, to the species collected during the cruise of the *Challenger*. The "Indian representative of the genus Bebryce" belongs to the Muriceidæ; but the interesting *Sarakka crassa*, Dan., belonging to the Alcyonidæ must be added to the list. Seven new species are described and figured, in addition to the last mentioned species, and figures are given of *Siphonogorgia kollikeri* and *Telesto trichostemma* which were described in the original Report. To the fourteen pages of the Report is added a list of the Alcyonaria (Pennatulacea excepted) obtained during the voyage, arranged according to the order of the stations at which they occurred; this comparatively useless record occupies ten pages, and is followed by a four page account of the bathymetrical range of the species, which takes no account of the record of the ranges as given in the original Report, which omits references to some of the *Challenger* forms and alludes to a large number of genera not found by the *Challenger*.

The six plates have been well drawn by Armbruster of Berne.

The third Report and the last of the series is by Prof. Ernst Haeckel, on the deep-sea Keratosa.

It will be remarked that this is not a "supplementary" Report to the Report on the Keratosa by Dr. Poléjaeff published in 1884, and it may be mentioned that the forms herein described appear to be of a very doubtful nature, "several spongiologists (among them some well known authorities) had denied their sponge nature and declared that these peculiar objects were either Rhizopods or other Protozoa. Other naturalists on the contrary who were closely acquainted with the Rhizopods, could not acknowledge their Rhizopod nature, neither could they make out the class to which they belonged." Possibly Prof. Haeckel was even one of these later for he tells us that "A *closer* comparative examination of these doubtful

organisms of the deep sea has led me to the conviction that they are true sponges, for the most part modified in a peculiar manner by the symbiosis with a commensal organism which is very probably in most cases (if not in all) a Hydropolyp stock."

Four families and eleven genera of these strange forms are described, and the species are well illustrated. With some few of them we may have had a previous acquaintance, but these turn up here with quite new faces; for, "to avoid further confusion," the author "proposes to employ the term Haliphysema for that monothalamous Foraminifer in the sense of Mobius, Brady, and most recent authors"; while "for the true Physemaria, however," which he described in 1876 "as *Haliphysema primordialis*, &c., it will be best to adopt the term Prophysema," and he thinks that "it may be that the body-wall (in these Physemaria) is perforated by numerous microscopical pores, and that these were closed temporarily and accidentally during the few hours I was examining them; in this case they are Ammoconidæ," that is, belong to the first family of these deep-sea Keratosa.

In the truly extraordinary forms placed in the fourth family of Stannomidæ, containing specimens taken from depths of between 2425 and 2925 fathoms, we find present a fibrillar spongin skeleton, composed of thin, simple or branched spongin fibrillæ, never anastomosing or reticulated and also symbiotic Hydroids. Haeckel thinks that these "fibrillæ" throw some light on the peculiar filaments met with in the Hircinidæ, and that in both instances these fibres are not independent organisms, but are produced by the sponges, in which they occur, and should be regarded, as "monaxial Keratose spicules."

In concluding this notice of one of the most remarkable of the series of animal forms found during the expedition of the *Challenger*, we feel compelled to protest against the style of the author's criticisms on Poléjaeff's previously published Reports on the Keratosa. It is very easy to write that "the whole systematic work of Poléjaeff turns in a large *circulus vitrosus*," &c., &c., but is it fair or just for one Reporter to thus, at the expense of Her Majesty's Treasury, write of a fellow Reporter? Such sentences must have been overlooked by the editor.

This Report extends to ninety-two pages, and is accompanied by an atlas of eight coloured plates.

THE VERTEBRATES OF LEICESTERSHIRE AND RUTLAND.

The Vertebrate Animals of Leicestershire and Rutland. By Montagu Browne. Pp. 223, illustrated. (Birmingham and Leicester, 1889.)

As we are informed in the preface, the volume before us is the first complete work treating of the vertebrate fauna of the two counties mentioned in the title, which has hitherto appeared, although scattered notes and a few lists have been published by several writers. The author, who, from his position as Curator of the Town Museum at Leicester, has exceptional opportunities for a work of this nature, can certainly claim that the result of his labours does not err on the side of incompleteness. Thus this volume is not only a record of all the existing species of vertebrates which have been observed within the limits of the counties in question, but likewise includes the fossil forms hitherto described from the same area. The recent and extinct forms are, indeed, arranged together in a systematic manner, without any difference of type or other indication to distinguish at a glance the fauna of the present from that of the past; and it is certainly rather startling, at first sight, to find in a fauna of an English Midland county the dormouse immediately followed by elephants and rhinoceroses. Now, although we are not on the side of those who regard the sciences of zoology and palæontology as separated by a wide gulf, yet we venture to think that in this instance the author would have been better advised had he given his synopsis of extinct types in a separate portion of the volume, after having first dealt with the existing species. Faunas are, indeed, to a very large extent, features of one particular epoch; and when we have those of two or more distinct epochs mixed up together, we tend to lose sight of the peculiar features of each one. The ordinary student of the local distribution of existing English mammals will find that the introduction of a number of extinct types, of which he knows nothing, tends to distract his attention from the observations regarding the local distribution of the living forms. Fortunately, indeed, this objection does not apply to the birds, in which no extinct forms are recorded.

The very natural tendency on the part of the author to make as much as possible of his subject, probably accounts for the introduction of some groups or species which might have been better omitted, or, at all events, passed over with a brief foot-note. Thus, in the first place, the introduction of the family *Hominidæ* could have been very well spared, at all events in the systematic arrangement. Then, again, the devoting of nearly two pages to the order Cetacea seems to be very unnecessary, seeing that the only ground for the introduction of this order into the fauna of Leicestershire is that the bones of whales are sometimes used as gate-posts, or in one instance as an ornament to a carriage-drive! The author's remark in the latter instance that he records "these, lest, in the event of their getting loose and being subsequently dug up, they should be mistaken for bones of an extinct elephant," reads as though intended for a caustic sarcasm against palæontologists. As another instance, we may mention the case of the avocet (p. 150), introduced on the ground that a gentleman fishing at the junction of the Soar with the Trent, at the extreme northern limit of West Leicestershire, saw what he believed to be an example of this bird flying overhead. The inclusion of species on this account would almost justify passengers passing through a town by railway being entered among the list of visitors thereto.

The same natural tendency to make the most of the subject will probably account for the introduction of sub-ordinal and sectional names (*e.g.* Carnivora Vera, Æluroidea, Arctoidea, &c.) which are of no possible importance in a work of this nature, and are really an incumbrance.

The author tells us he has followed the latest descriptions throughout his work, and we see that in several instances he is even in advance of many writers in regard to the adoption of early names on the ground of priority. Thus the name *Microtus* is employed for the voles, in lieu of the well-known *Arvicola;* but in this particular

instance it would surely have been well for the author to have departed from his rule and introduced the latter term as a synonym. A still more glaring instance of the inadvisability of dropping all mention of synonyms occurs in treating of the lesser shrew (p. 13), for which the name *Sorex minutus*, Linn., is adopted, in place of the later *S. pygmæus*, Pall. Now, the author refers to Bell's "British Quadrupeds" for the distinctive characters of this species, which is there mentioned only as *S. pygmæus;* thus laying himself open to the criticism of those who are not specialists that he has confused the terms *pygmæus* and *minutus*. This species has, moreover, never been recognized in the district, so that its mention seems rather unnecessary. In discarding the name *Lepus timidus* in favour of *L. europæus* for the common hare, our author follows those who regard the letter of the law as more than the spirit; and although there is but little, if any, doubt that at least some of the hares to which Linnæus applied the name of *L. timidus* were really of that species to which we commonly apply the name *L. variabilis*, yet we cannot help thinking that the former name might be advantageously retained in its common acceptation.

Among the Ungulata, the author retains the fossil *Bos longifrons* (*frontosus*) as a distinct species, although it has been shown over and over again that it can only be regarded as a race of *B. taurus*. Similarly, all recent observations tend to show that *Bos primigenius* is nothing more than a larger variety of the same species; while there appear to be no valid grounds for specifically distinguishing the Pleistocene *Bison priscus* from the living Lithuanian aurochs. The author would confer a great benefit upon palæontologists if he could show how the skull he refers to the so-called *Sus palustris* can be specifically distinguished from one of *S. scrofa*.

In commenting upon the absence of remains of fossil Carnivora from the Leicestershire Pleistocene, Mr. Browne does not appear to be aware how extremely rare these remains are in the equivalent deposits of other counties. Thus, at Barrington, in Cambridgeshire, where bones and teeth of Ungulates are found by the hundred or thousand, those of Carnivores may be reckoned by units or tens; and the introduction of special hypotheses to account for their absence in Leicestershire is, therefore, quite superfluous.

The total number of mammals mentioned is forty-eight (including man), but of this list only twenty-five are now found in a wild state in the area described. The number of species of birds is very large, as we might expect in an area of the size of that forming the subject of the work. Several species, such as the gannet, cormorant, &c., are, however, but occasional stragglers from the coast; while in other cases, as we have already remarked, the evidence of occurrence within the two counties is of the slightest. A good lithographic plate of Pallas's sand-grouse, and a coloured one of the cream-coloured courser, are given; and we also have an elaborate table of the dates of arrival of summer immigrants. In the reptiles, the five existing species are almost lost among a number of fossil forms, to which they have but a very remote kinship. This swamping of recent forms by their fossil allies is, however, not so marked among the fishes, owing to the circumstance that all the fossil forms belong to extinct families, which follow the recent ones. Mr. Browne follows Prof. Cope in abolishing the orders Teleostei and Ganoidei, and arranging the representatives of the former and the typical groups of the latter in a sub-class Teleostomi, which is ranked as equivalent to the Elasmobranchii. The *Salmonidæ* are thus immediately followed by a family which the author, in defiance of all grammatical rules, terms *Leptolepidæ*, and which forms a transition from the Ganoids to the Teleostei. It seems strange that, while employing the correctly-formed term *Rhizodontidæ* (instead of *Rhizodidæ*), the author should retain names like *Leptolepidæ* and *Osteolepidæ* in place of *Leptolepididæ* and *Osteolepididæ*; but here, perhaps, he merely follows those who ought to know better. The number of fossil fishes from the Lias quarries of Barrow-on-Soar is very considerable; and we believe that the Leicester Museum is rich in this respect, as well as in the remains of Saurians from the same locality.

The author seems to have spared no labour in looking up references and making his work in all respects as nearly complete as possible; and, since the volume is handsomely got up and well printed, with a remarkable freedom from misprints, it should take a place in the first rank of local faunas. R. L.

THE SCIENTIFIC PAPERS OF ASA GRAY.

Scientific Papers of Asa Gray. Selected by Charles Sprague Sargent. Two Vols. (London: Macmillan and Co., 1889.)

NO more fitting monument could have been raised to the memory of the late Dr. Asa Gray—who was almost as well known to botanists on this side of the Atlantic as on the other—than a reprint of a selection of his numerous writings. During a period of upwards of fifty years he was actively engaged in the investigation and publication of the botany of North America, and studies of a wider range. As Prof. Sargent says, in his preface to the present collection, "The number of his contributions to science and their variety is remarkable, and astonishes his associates even, familiar as they were with his intellectual activity, his various attainments, and that surprising industry which neither assured position, the weariness of advancing years, nor the hopelessness of the task he had imposed upon himself, ever diminished."

The hopeless task, it may be explained, was a complete "Synoptical Flora of North America." Botanists need not be told how he laboured to complete this gigantic undertaking, even at an age when most men are past work. Taking up the work where the unfinished "Flora of North America," by Torrey and Gray, ceased thirty-five years previously, Gray published the remainder of the Gamopetalæ in 1878. This was followed in 1884 by a re-elaboration of the Compositæ and neighbouring natural orders; and the whole was re-issued in the form of one volume in 1886. This volume comprises about 1000 closely printed pages of descriptive matter—descriptive matter perhaps unsurpassed in botanical literature, and dealing with 567 genera and 3521 species. Whatever may be done by Gray's successors towards completing the "Synoptical Flora," his own contribution is a

most valuable one—valuable because it embodies the whole of his numerous scattered writings on the group in question.

In making a selection of Dr. Gray's work for republication, Prof. Sargent naturally did not choose descriptive botany, though an index to the genera and species described in a variety of more or less inaccessible publications would be of the utmost service to botanists; for even under the most favourable conditions a long time must elapse before the completion of the "Synoptical Flora."

The selection, "which was found difficult and embarrassing," is limited to reviews of works on botany and related subjects, essays, and biographical sketches, and it is on the whole, doubtless, as good a one as could have been made. Gray wrote "more than eleven hundred bibliographical notices and longer reviews," and, as space for only fifty is found in a volume of 400 pages, it follows that "it was necessary to exclude a number of papers of nearly as great interest and value as those which are chosen."

Dr. Gray's method, if I may so term it, of reviewing the productions of his contemporaries was of such an instructive, temperate, and impartially critical character that these reviews have a permanent value. On reading some of them again, one is more than ever impressed with the fact that he made himself thoroughly acquainted with the works he criticized, and that he well fulfilled his duty alike to the public and the author. He did not hesitate to point out what he regarded as defects in the writings of his most intimate friends; but he was more careful to give an analysis of the contents of a book, with his own views thereon, than to condemn it on its faults or weak points.

These reviews cover a wide field, as well as a long period, and still remain profitable and interesting reading. The selection is too limited to be a history of botany during the last half-century, but it is sufficiently comprehensive to give an idea of the most notable events. It is true that the essays on the Darwinian theory are not here reproduced, as they had already been republished by their author.

The first volume, which is devoted to reviews, commences with a detailed notice of the second edition of Lindley's "Natural System of Botany" and ends with Ball's "Flora of the Peruvian Andes," reminding us of our most recent loss in the very small circle of private gentlemen who may be said to have studied botany successfully.

Early among the reviews is that of Endlicher's "Genera Plantarum," a work published at intervals between 1836 and 1840; and, almost at the end, a short article on the completion of Bentham and Hooker's "Genera Plantarum," 1862-83. In the latter we find a comparison of the number of genera admitted in various works of the same class, from the appearance of the first edition of Linnæus's "Genera Plantarum," in 1737, down to Bentham and Hooker, and remarks on the ideas of generic limits entertained by the different authors, and on the relative quality of their work.

Interspersed between these are notices of such widely different subjects as De Candolle's "Prodromus"; von Mohl's "Vegetable Cell"; Boussingault, "On the Influence of Nitrogen"; Bentham's "Hand-book of the British Flora"; De Candolle's "Géographie Botanique"; Hooker's "Distribution of Arctic Plants"; Ruskin's "Proserpina"; Darwin's "Insectivorous Plants"; and Wallace's "Epping Forest."

Among the fourteen "Essays" in the second volume, those on the longevity of trees, the flora of Japan, Sequoia, and forest geography and archæology, may be named as specially interesting.

The biographical sketches are thirty-eight in number, ranging from Brown and Humboldt to Bentham and Boissier. As only some two hundred pages are devoted to them, these sketches are, many of them, necessarily very brief; but, as Gray had a personal knowledge of most of the men of whom he wrote, they contain original and interesting observations and facts not to be found elsewhere. And all who knew Dr. Gray will enjoy reading again his opinion of other men and their works.

W. BOTTING HEMSLEY.

MANURES AND THEIR USES.

Manures and their Uses. By Dr. A. B. Griffiths. (London: George Bell and Sons, 1889.)

THIS is a hand-book for farmers and students, and may be described as a smaller and less ambitious successor to the treatise on manures, by the same author, reviewed some months ago in NATURE. The principal value of this latter work consists in the direct information it contains as to sources of phosphatic, potassic, and nitrogenous manures, including guanos, in all parts of the world. The analyses, localities, amounts imported, and values, are all interesting facts for farmers, and this little book may well take its place in an agricultural library as supplying knowledge which otherwise might need research through many scattered sources of information. When, however, we consider the book as a means for imparting sound views on agricultural principles, we must advise caution on the part of the reader. Dr. Griffiths is one of those teachers who are infected with an inordinate affection for chemical manures. He believes, with M. Ville, that "the farmer who uses nothing but farmyard manure exhausts his land." Now, a man who starts with such an obvious fallacy can scarcely get into the right path. This doctrine is contrary to science and practice; and until Dr. Griffiths relinquishes it he cannot hope to enjoy the confidence of any farmer. We venture to put the matter in two or three positions from which it can be clearly viewed. Dr. Griffiths says, "This [farmyard] manure is erroneously supposed to contain *all* the necessary plant-foods required for the growth of crops." Erroneously! why, farmyard manure at least must contain all the constituents of straw, for it is largely made of straw. Similarly, it must contain the elements of turnips and root crops, when it is composed of them in no small proportion. Also it must contain the constituents of corn, because all meals and cakes which are consumed by cattle, and all hay, which is also consumed by cattle, contain the constituents of corn in the form of nitrogen, phosphorus, sulphur, potash, lime, magnesia, &c. Whether looked at chemically or approached through pure reasoning, it is clear that farm-

yard manure is the true restorer of fertility, the very milk of plants, the very life-blood of the soil, if such an expression may be allowed. Farmyard manure during its decay has its elements liberated from organic combinations gradually, and when wanted, as well as in a condition so available for the food of plants, that as a manure it is inimitable. No other manure can in all cases be applied to all crops with the same marked effects. It is strange that farmyard manure alone acts promptly and certainly upon leguminous crops such as beans, peas, and clover. No chemical manure, whether nitrogenous or phosphatic, can be relied upon to affect these crops, and yet farmyard dung tells upon them at once. Dr. Griffiths lays stress upon the fact that animals retain phosphates and nitrogen for the formation of bones, nerves, and muscles, and therefore to some extent rob the land. This fact is, however, entirely over-ridden by the customary importation of extraneous matter on to the farm in the form of foods purchased. The amount of phosphates and nitrogen removed by animals in their bodies is as nothing compared to the tons of cake, meal, hay, and even roots which are imported. Neither must we forget the town manure which is so often bought by farmers, and which will compensate for such a loss as that which Dr. Griffiths fears. Too much prominence is given to chemical manures, and too little importance is attached to stock-feeding as a manurial agency. Dr. Griffiths quotes many writers upon matters on which they are scarcely to be regarded as authorities. On such matters he might just as well have told us his opinion, instead of backing it up with the name of a solicitor who has been dead for years and whom nobody now knows of. Neither is an agriculturist, pure and simple, an authority on a chemical point such as the valuation of farmyard manure on the basis of its chemical constituent parts.

Dr. Griffiths claims to have made a discovery with regard to the use of iron sulphate as a fertilizer, and a good deal of space is devoted to this subject, which is not without interest. Half a hundredweight of iron sulphate per acre produces extraordinary results, according to experiments recorded in this book. No doubt this is Dr. Griffiths's great point, and far be it from us to detract from its significance. If it is as potent a fertilizer as Dr. Griffiths thinks, we shall probably hear more of it. He is evidently not the man to let the matter rest. W.

OUR BOOK SHELF.

Histoire Naturelle des Cétacés des Mers d'Europe. By P. J. Van Beneden. Pp. 664. (Brussels: F. Hayez. 1889.)

It is fifty-three years since the veteran Professor of Zoology in the University of Louvain published his first paper on the Cetacea, entitled "Caractères spécifiques des grands Cétacés tirés de la conformation de l'oreile osseuse." During the greater part of this long period he has made this group of animals especially his own, having industriously collected from every available source information upon them, which he has given to the world, not only in his great works on the osteology of the Cetacea and the fossil Cetacea of Antwerp, but also in a series of memoirs which have appeared from time to time in the publications of the Belgian Academy of Sciences. During the last three years the "Mémoires couronnés et autres Mémoires," published by that learned body in octavo form, have contained a number of articles from his pen upon the Cetacea of the European seas, and it has been a happy idea of the author to collect these together, and republish them in a handy form, so as to render them accessible to many who would have difficulty in referring to them when scattered throughout the pages of the journal in which they first appeared.

The work treats systematically of all the species known to inhabit any of the seas by which Europe is surrounded, and under each species are sections devoted to the literature, the history, the synonymy, the characters, the organization, the habits, the geographical distribution, the mode of capture, the museums in which specimens are known to exist, the published figures, and finally an account of the commensals and parasites which dwell upon or within them. On all these subjects the information given is derived from years of close and diligent gathering, and the result is an exhaustive account of our present knowledge of the European Cetacea. As a book of reference to all who are engaged in the study of cetology this work is absolutely invaluable, and if figures, even in outline, of all the species had been added, it might have gone far to occupy the place of the much-needed popular hand-book of this still little understood, though interesting order of mammals.

The number of species admitted is judiciously restricted, many of those appearing in previous works being relegated either definitely or provisionally to synonyms. Twenty-six are, however, left, all undoubtedly distinct forms. Of these, seven are whalebone whales, viz. *Balæna biscayensis*, *B. mysticetus*, *Megaptera boöps*, *Balænoptera rostrata*, *B. borealis*, *B. musculus*, and *B. sibbaldii*; five are Ziphioids, viz. *Physeter macrocephalus*, *Hyperoödon rostratus*, *Ziphius cavirostris*, *Micropterus sowerbyi*, and *Dioplodon europæus*; and the remaining fourteen are Delphinoids, viz. *Phocæna communis*, *Orca gladiator*, *Pseudorca crassidens*, *Globicephalus melas*, *Grampus griseus*, *Lagenorhynchus albirostris*, *L. acutus*, *Eudelphinus delphis*, *Tursiops tursio*, *Prodelphinus tethyos*, *P. dubius*, *Steno rostratus*, *Delphinopterus leucas*, and *Monodon monoceros*. The only exceptions we can take to this nomenclature are the adoption of the generic term *Micropterus* in preference to *Mesoplodon*, as the former was preoccupied by a genus of Coleoptera, and the use of the needless term *Eudelphinus* for the common dolphin. If this should be generally accepted, the good old Linnean genus *Delphinus* would disappear altogether from the list. That it should be greatly restricted by the lopping off of aberrant branches was inevitable, but surely the name might have been left for such a characteristic species.

W. H. F.

Hand-book of Practical Botany for the Botanical Laboratory and Private Student. By E. Strasburger. Edited, from the German, by W. Hillhouse, M.A., F.L.S. Second Edition, Revised and Enlarged. With 116 original and 33 additional Illustrations. (London: Swan Sonnenschein and Co., 1889.)

The first edition of Prof. Hillhouse's translation of Strasburger's "Practical Botany" was reviewed in Nature (vol. xxxv. p. 556). The new edition has been considerably enlarged, and is now intermediate in extent between the smaller and the larger German editions. The new matter, mainly derived from the larger "Botanisches Practicum," second edition, adds greatly to the value of the book. The most important additions are the accounts of the reproduction of Fucus and of Chara, and of the fertilization and embryology of Picea. The much fuller description of the reproduction of Mucor must also be noticed, as well as the considerable alterations, affecting both text and figures, in the chapters on vascular bundles. Further, the structure of the grain of wheat is now described—a very useful addition.

Some verbal inaccuracies which had crept into the first translation have been corrected, and in every respect the editor may be congratulated on the work in its present form. It will be of the greatest use to students—especially, perhaps, to those who have to work alone.

D. H. S.

Traité d'Optique. Par M. E. Mascart. Tome I. (Paris: Gauthier-Villars, 1889.)

THIS is the first half of a very elaborate treatise on optics, the full scope of which we cannot tell till the second volume appears, as no hint is given of what is yet to come. This first volume begins with the fundamental principles of the wave-theory of light, deduces from them the elementary laws of geometrical optics, discusses the properties of a co-axal system of refracting surfaces, describes the structure of the eye, expounds the facts of colour-mixture, points out the conditions which determine the resolving power of a telescope, develops at great length the theories of diffraction and interference, with some of their principal applications, and devotes about 80 pages to polarization and double refraction. There is practically nothing about the microscope, and nothing at all about the paths of rays in media of continuously varying density.

The book is by no means easy reading, and the labour of perusing it is increased by the smallness of the reference letters (with their numerous accents and suffixes) which occur in the figures. The plan involves much specialization. For instance, the proof of the formula for retardation on which the theory of Newton's rings depends is not given in the sections devoted to Newton's rings and colours of thin plates, but some 370 pages earlier. In many cases, when the student has found a formula which appears to contain the information of which he is in quest, he has to search carefully through a long series of preceding pages before he can find the meaning of some symbol which occurs in it. The volume contains a vast store of information, but not generally in a form to suit hasty seekers after truth. It requires to be studied at leisure, and the time so spent will not be wasted. Great pains have obviously been taken to embody the latest information and present it in the clearest form. We may instance the spiral curves which illustrate the values of Fresnel's integrals, and the curve (to which a folding-plate is devoted) showing the relations of the colours of diffraction fringes to the three primary colours. There is an excellent discussion of the theory of concave gratings, both for reflection and refraction. The least attractive chapter is that entitled "Properties of Vibrations." It is a discussion of the composition of simple harmonic motions, and occupies 40 pages bristling with elaborate formulæ. We think a more moderate display of mathematics under this head would have sufficed.

The order of arrangement adopted in the volume is rather peculiar, and baffles all *a priori* conjecture. For instance, the discussion on colour-mixtures occurs in a chapter on "Interferences," and the investigation of the conditions which determine the resolving power of a telescope is given in the introductory chapter under the head of "Preliminaries."

The book is essentially a mathematical treatise, all experimental descriptions being reduced to the narrowest possible limits.

The preface states that the work is addressed mainly to "pupils of the Faculties and Schools of higher instruction," but we think its principal use in this country will be as a book of reference for teachers. Its value for this purpose will be greatly increased if a good alphabetical index is added at the end of the second volume.

J. D. EVERETT.

Bibliothèque photographique: Le Cylindrographe, Appareil panoramique. Par P. Moëssard, Commandant du Génie breveté, attaché au Service géographique de l'Armée. (Paris: Gauthier-Villars, 1889.)

THIS is a description of a photographic camera invented by Colonel Moëssard, in which the lens is pivoted on an axis, and the sensitive film is arranged in a cylindrical form about this axis, on a radius equal to the focal length of the lens. By this means a panoramic view of angular breadth up to 170° can be taken. The camera being fixed in position, the lens is uncapped, and then rotated quickly or slowly, according to the speed of the plate, and the intensity of light in any direction. The author claims for the instrument useful employment in surveying, either in the carefully detailed plans of an ordnance survey, or in the rapid views useful for warlike purposes, which the instrument can afford. Two photographs taken with the aid of the instrument illustrate very favourably its powers, especially for architectural purposes.

A Hand-book of Modern Explosives. By M. Eissler. (London: Crosby Lockwood and Son, 1889.)

IN this book the author of "Modern High Explosives" has collected much useful information about the various explosives now in use. The greater part of the work is devoted to nitro-compounds, but short accounts of the other types of explosives now being manufactured are added. The manufactures of gun-cotton and nitro-glycerine receive full treatment, together with the modifications introduced in the various large factories both of America and Europe. The important subject of the use of explosives in fiery mines has a chapter to itself. The description of the tests of flameless powders is of especial interest; in fact, the official reports of the tests of many of the most important explosives are perhaps the most instructive portions of the book. The chapter dealing with the practical application of explosives should be useful not only to the miner, but also to officers of both services to whom blasting and the use of explosives generally may at any time become a necessary auxiliary. An interesting account of the history and trials of the Lalinsky gun, together with the manufacture and use of gun-cotton shells, is also well worthy of their perusal. Little is said on the use of explosives below water, especially on the subject of the removal of wrecks, which would stand far fuller treatment. Four appendices are added, two dealing with the analysis and determination of stability of explosives, and one containing abstracts from the principal provisions of the Explosive Act of 1875. Although there is much that is necessarily old, still this is a book that will be read with interest by most who are accustomed to work with high explosives. The illustrations are well executed, and the whole wonderfully free from printer's errors.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Peltier Effect, and Contact E.M.F.

WITHOUT any further reference to the heading of a letter on p. 102, signed "The Reviewer," I wish to discuss an interesting argument therein propounded as proving that a true electromotive force at contact between two metals cannot be the cause or sole cause of the Peltier effect, unless the latter be simply proportional to absolute temperature. The argument is very like one that I indistinctly remember to have heard suggested some time ago by Prof. Schuster, and it struck me at the time as ingenious and not easily answerable.

On seeing it in print, however, a natural answer occurs to me, which it may be worth while to give. The whole point of the reasoning depends on assumed properties of vacuum.

The assumptions are as follow :—

(1) That a perfect vacuum is an absolute non-conductor of electricity.

(2) That no contact E.M.F. exists between a metal and a vacuum.

(3) That vacuum has a specific inductive capacity.

Grant all these, and the argument is sound. Decline to admit any of them, and it proves nothing. Break down the first two of them, and it proves too much: it proves the non-existence of any thermal contact-force whatever between conductors. For if there were any E.M.F. at the metallic contact, and none at the other or vacuum contacts, a continuous current would flow, propelled by energy derived from a cold place.

This argument is indeed the ordinary one to prove that the algebraic sum of the E.M.F.'s at all the junctions of a closed conducting circuit in which no energy but heat is supplied must be zero when the temperature is uniform.

The proof scarcely holds when insulators are interposed, though the *fact* may be true nevertheless. When chemically active substances with their extraneous supply of energy are interposed, the fact itself is no longer true. But how do we know what is true when vacuum is interposed? The hypothesis on which the argument is founded is a baseless conjecture.

But it may be said, Are not the hypotheses probable? Do you not yourself believe them? I believe in (1) and (3) provisionally, but certainly not in (2). The contact E.M.F. between two substances is probably some surface action or skin phenomenon, and I see no reason why it should not occur as well in the boundary between metal and void as in the boundary between one metal and another. Indeed, it is not improbable that the sum of the E.M.F.'s in *every* circuit of chemically inert substances, whether conducting or not, and inclusive of vacuum, is zero under uniform temperature conditions.

All that is wanted to establish this is the knowledge that in a circuit of any one substance at non-uniform temperature the total E.M.F. shall be zero,[1] or that the Thomson effects in a single substance always balance each other; *i.e.* that the total E.M.F. in a circuit shall depend on a potential function of temperature, or $dE = f'(t)dt$.

Now it is quite true that this $f'(t)$ is the Peltier coefficient divided by absolute temperature, and that $f(t)$ in its most general form contains an arbitrary constant, but what of that? Nothing is known of $f(t)$ except that it is a potential function: it is not known to represent any physical effect. I never said that the Peltier effect enabled us to find the most general form of the function $f(t)$; I said it gave us the E.M.F. at a junction.

And there is much ground for the assertion; for it is easy to show that in a simple AB circuit, with junctions at t_1 and t_2, the total E.M.F. is

$$E = \Pi_1 - \Pi_2 + \int_{t_2}^{t_1} (\Theta_A - \Theta_B) dt ;$$

just as if the resultant E.M.F. were the algebraic sum of two Peltier E.M.F.'s and of two Thomson E.M.F.'s.

My only contention is that this equation, which is undeniably true when the Π are interpreted as heat-coefficients, is also true and immediately interpretable when they stand for contact E.M.F.'s. The burden of proof as to the physical existence of an unnecessary and in every sense arbitrary constant rests with those who doubt this simple explanation.

It is difficult to see how a doubt can arise, or how the Peltier and Thomson productions or destructions of heat can be accounted for without local E.M.F.'s. Nohow, so Dr. Hopkinson has proved, and I also have insisted (*Phil. Mag.*, October 1885, and March 1886), except by some wildly gratuitous assumption of an actual physical specific heat for electricity, dependent on the temperature and on the metal in which it happens to be.

Liverpool, December 14, 1889. OLIVER J. LODGE.

[1] Hopkinson virtually pointed this out, *Phil. Mag.*, October 1885.

Mirages.

THE article in NATURE of November 21, 1889 (p. 69), recalls to me mirages I saw in March 1888, while travelling in the East on the steam yacht *Ceylon*.

On the 29th we were crossing the Black Sea from Sebastopol. It was a fine cool day and quite calm. In the afternoon a false or mirage horizon about 3° above the true one was visible for a few hours. No objects were within range of vision. The mirage disappeared as the sun declined.

The next day was very much warmer, and we saw a more marked and interesting mirage in the afternoon as we were steaming across the Sea of Marmora away from Constantinople. In this case it appeared only in the west, and objects were seen reflected in an inverted position. A small conical-shaped island was seen with its inverted image at times distinct from and at times blending with the original. The image was distinctly seen of some land, which was actually below the horizon. The mirage of the reflection of the sun in the sea was, when seen through a glass, especially beautiful. It resembled a glorious cataract of golden water. This mirage lasted till quite the dusk of the evening, and then gradually thinned down and died away.

I do not know whether mirages at sea are uncommon; but as the officers on board did not remember seeing one before, I thought these instances might be worth recording.

ARTHUR E. BROWN.

Thought Cot, Brentwood, December 31, 1889.

Self-luminous Clouds.

I AM very sorry that I took no notes, some six or seven years ago, on the first and only occasion of my seeing self-luminous clouds, but though I can give neither date nor positions, the following facts are still fresh in my memory.

Passing through Bushey Park after dark, I noticed an aurora borealis, and, as I had only recently seen the rather rare phenomena of the rays of the setting sun converging towards a point in the east, I followed the direction of one of the principal beams of light towards the south, when, at a point somewhat south of my zenith, I noticed an equatorial belt of luminous clouds. I found that each cloud belonged to a ray, and faded and brightened with it, but was separated by about 60° of clear sky. This belt of clouds extended down to the western horizon, the eastern one was obstructed by trees, while shortly afterwards small dark clouds appeared on that side, and the sky soon became overcast.

The luminous clouds were quite transparent, so that even faint stars could be seen through them when at their brightest. I have heard from Scandinavian captains that these luminous belts are sometimes seen in northern latitudes, and are sure signs of bad weather. I have written these few remarks in the hope that those of your readers who may have the chance of seeing an aurora borealis will also look out for these clouds, and if possible determine their position. C. E. STROMEYER.

Strawberry Hill, January 4.

The Revised Terminology in Cryptogamic Botany.

THE anglicized forms of most of the terms in common use, employed in the "Hand-book of Cryptogamic Botany" recently issued by Mr. G. Murray and myself, have not up to the present time found much support from our fellow-botanists. I propose, therefore, to give, in some detail, the reasons which have induced us to adopt them, and to urge their general use on writers on cryptogamic botany. For this purpose we will take as our text extracts from three reviews of the "Hand-book," marked, as all the critiques have been, with only one or two exceptions, by a generous appreciation of the difficulties of our task, and a too great leniency to the many shortcomings of the work :—"The most conspicuous, though not the most important, of these [changes] is the adoption of anglicized terminations for Latin and Greek technical words. This is a matter in which it is hard to draw the line aright. . . . As a matter of taste we think the authors have gone much too far in this direction. They complain of the 'awkwardness and uncouth form of these words'; we should have thought the reproach applied much more strongly to 'cœnobe,' 'sclerote,' 'nemathece,' and 'columel'" (NATURE). "An Englishman may guess what 'archegone' is short for, for example; but why puzzle a foreigner with a new form of a word with which he is familiar in every treatise hitherto written on the special subject in any European language?" (*Academy*). "Too sanguine expectations on this head might well be toned down by remembering the complete failure of the somewhat similar experiment made by Lindley. . . .Primworts, spurgeworts, bean-capers, and hip-

purids are decidedly simpler, even if less euphonious, than Primulaceæ, Euphorbiaceæ, Zygophyllaceæ, and Haloragеæ; yet the longer Latin terms are still universally used, while the quasi-English ones have never obtained even temporary acceptance" (*Journal of Botany*).

The last of these criticisms appears to rest on a confusion between the principles of nomenclature and those of terminology. In nomenclature, rigid rules have been laid down, and accepted by all leading naturalists of all countries, in order that the scientific names of species, genera, orders, &c., may correspond in scientific treatises in all languages. In the terminology of flowering plants no such rule has ever been attempted to be laid down; but each writer, when writing in his own language, uses terms, usually of classical origin, and derived from common roots, but of a form as far as possible amenable to the laws of the language in which he writes. All that we are contending for is the extension of the same principle to cryptogamic botany; one of the main objects in the publication of our "Hand-book" being to make the study of flowerless plants as attractive to the public at large as is that of flowering plants.

In order to show how recent is the universal adoption of this practice in phanerogamic botany—a change largely due to the influence of Dr. Lindley's writings—we append a list of a few terms in use in standard works of original research or of reference, published within the last thirty-two years, which presented themselves the first to our hand; viz.—"The Miscellaneous Botanical Works of Robert Brown" (1866); Mr. Currey's translation of "Hofmeister on the Higher Cryptogamia, &c." (1872); Berkeley's "Introduction to Cryptogamic Botany" (1857); and Bentley's "Manual of Botany" (2nd ed., 1870):—

Achænium	Bentley	*Ovulum*	Brown
Anthera	Brown	*Perianthium*	Brown
Arillus	Bentley	*Pericarpium*	Brown
Bractea	Brown	*Pistillum*	Brown
Carpellum	Brown	*Rhizoma*	Berkeley
Integumentum	Berkeley	*Spermatozoon*	Currey
Involucrum	Brown	*Stamina* (plural)	Brown
Ovarium	Brown	*Stipula*	Currey

With the exception of words which have been incorporated into our language, such as *corolla*, *nucleus*, &c., comparatively few of those used in describing flowering plants now retain their classical forms; the most conspicuous exceptions being those applied to the structure of tissues, such as *epidermis* and those ending in *enchyma;* and can anything be more puzzling than the forms in common use for the terms derived from the Greek δέρμα—*epidermis, hypoderma*, and *periderm?* We have no doubt that, had our critic lived in the days of Robert Brown and Lindley, he would have thought all the innovations introduced by the latter "uncouth" simply because we were not used to them; and would have said that Lindley had "gone much too far." In some of those adopted by ourselves we have, in fact, been forestalled by others, as in the cases of *antherid* and *archegone* by Lindley, and *sporange* by Oliver.

We now come to the charge made by our critic in the *Academy*, that the terms we have introduced would "puzzle foreigners." Unfortunately, our polyglottism, or rather oligoglottism, will not allow us to vie with our reviewer in his acquaintance with every European language; we are compelled to confine ourselves chiefly to three; but these include by far the greater part of European botanical literature—in fact, every treatise which nine out of ten English readers will wish to consult in the original. The statement quoted above seems to have been rashly made.

In *Italian*, as far as our knowledge goes, the practice is absolutely uniform: no botanical writer of repute uses the classical forms; but every technical term has its Italian spelling and termination. To such an extent is this adaptation to the laws of orthography of the language carried, that we find "xylem" converted into *xilema*, "phloem" in to *floema*, "hormogonium" into *ormogonio*, and "hyphæ" into *ife;* and this by the first writers "on special subjects."

Our acquaintance with *Swedish*, *Danish*, *Dutch*, and *Spanish* is too slight to allow us to speak with confidence; but in all these the general practice is, we believe, the same as in Italian, though not to the same extent; with the best writers, when writing in their own language, the use of terms with Latin or Greek terminations appears to be the exception rather than the rule.

In *French*, the practice is by no means so uniform as in Italian; but still that of the highest authorities is, on the whole, very decidedly in favour of French, rather than Latin or Greek, forms of the words in most common use. From works picked up almost at random, we select the following:—

Anthéridie	Van Tieghem, Guignard, Philibert, De Wildeman, Bornet, Thuret.	*Parenchyme*	Guignard, Heckel, Fayod, Bornet, Tulasne.
Archégone	Van Tieghem.	*Perithèce*	Costantin.
Baside	Tulasne, Roumeguère (*basidie*, Fayod).	*Pollinide* (Florideæ)	Guignard.
Capitule	Bornet.	*Procarpe*	Bornet, Thuret.
Conidie	Costantin, Roumeguère (*conid*, Bornet).	*Propagule*	Bornet.
Épiderme	Van Tieghem, Rénault.	*Prothalle*	Guignard.
Favelle	Bornet, Thuret.	*Pycnide*	Costantin, Roumeguère.
Gamétange	De Wildeman.	*Sclérote*	Van Tieghem, Fayod.
Glomérule	Bornet, Tulasne.	*Sore*	Thuret.
Gonidie	De Wildeman.	*Sporange*	Bornet, Thuret, Roumeguère, Tulasne, Van Tieghem, De Wildeman, Guignard, Philibert.
Hormogonie	Bornet.	*Stipe*	Fayod, Roumeguère.
Hyphe	De Wildeman.	*Stomate*	Philibert, Thuret.
Nucléole	Guignard.	*Thalle*	Thuret, Gay, De Wildeman, Fayod.
Oogone	De Wildeman (*oogonie*, Roumeguère).	*Zoosporange*	Flahault.
Opercule	Philibert.		
Ostiole	Thuret, De Wildeman.		
Paraphyse	De Wildeman.		

The great stronghold of the conservatives in terminology is the *German* language. No doubt a large number of the best writers do here maintain the classical form of most technical cryptogamic terms, including some in which it has already been abandoned with us, such as *conceptaculum*, *receptaculum*, *stolo*, and *perianthium*, just as we still meet with *ovarium*, *ovulum*, and *protoplasma*. This is no doubt largely due to the greater difficulty which the German language has than the French or our own in naturalizing aliens. But even here the practice is by no means uniform, and Germanized forms are coming yearly more and more into use. In order that there may be no question as to the recency and authority of the examples quoted, the following list has been compiled exclusively from the standard treatises in Schenk's "Handbuch der Botanik"; had other works of equal authority been consulted, the list might have been considerably extended:—

Apophyse	Goebel	*Hormogon*	Zopf
Archespor	Goebel	*Mycel*	Zimmermann
Basidie	Zopf	*Paraphyse*	Zopf
Carpogon	Falkenberg	*Parenchym*	Haberlandt, Zimmermann, Detmer, Schenk, Zopf
Cilie	Zopf	*Plasmod*	Zopf
Collenchym	Haberlandt, Zimmermann	*Prokarp*	Falkenberg
Conidie	Zopf	*Sklerenchym*	Haberlandt, Detmer, Schenk
Endospor	Goebel	*Sporogon*	Goebel
Enzyme	Zopf		
Epithel	Haberlandt		
Exospor	Goebel		

We do not mean that these words are exclusively used by the writers quoted; it is not uncommon to find the Latin and the German form used indifferently on the same page. It is noteworthy also that even the most rigid conservatives do not use the Latin form in the plural of such words as "oogonium," "sporangium," "antheridium," "sclerotium," &c., but always the German forms, *Oogonien*, *Sporangien*, *Antheridien*, *Sklerotien*, &c.; such words as "oogonia," "sporangia," "antheridia," "sclerotia," &c., are, as far as our experience goes, to be found only in English and American writings and in Latin diagnoses.

Analyzing, therefore, the statement that the Latin and Greek forms of words used in cryptogamic terminology are "familiar in every treatise hitherto written on the special subject in any European language," we find that in Italian the practice is unanimously, and in French (as also, we believe, in most other European languages) preponderatingly in the opposite direction; and that German is the only widely read language of Continental Europe in which even the weight of authority is still on that side.

There are some terms in which, no doubt, the classical form must be retained, especially those which, when deprived of their

classical termination, become monosyllabic, such as "thallus," "sorus," "hypha," and "ascus," just as we still speak of a "corolla," a "stigma," a "hilum," and a "raphe." But, with regard to the great majority of terms in current use in descriptive cryptogamic botany, we entertain not the smallest doubt that the change will gradually be brought about which has, within the last forty years, become established in phanerogamic botany; and we would venture to suggest to our fellow-workers in cryptogamic botany in this country and in America, whether it will not be best to accept it frankly once for all.

ALFRED W. BENNETT.

Exact Thermometry.

I AM quite in agreement with Prof. Sydney Young (NATURE, December 19, p. 152), that after the lapse of a sufficient time—let us say, an infinite time—the constant slow rise of the zero-point of a thermometer at the ordinary temperature will attain a definite limit; but I cannot accept his view that the effect of heating the thermometer to a high temperature is simply to increase the rate at which *this* final state is approached. If the results of experiment at the ordinary temperature be expressed in a mathematical formula which admits of making the time infinite, the limiting value of the rise (on that condition) will not exceed on the average 2° C., even in a thermometer of lead glass. After exposure to a high temperature, and in the same thermometer, so great an ascent as 18° C. is a possible measurement, actually realized. The two phenomena are therefore very different in their nature.

The view that, owing to the more rapid cooling of the outer parts of the bulb after it has been blown, the inner parts are in a state of tension, and that it is the gradual equalization of the tension throughout the glass that causes the contraction, has frequently been held, and will probably be for a long time the favourite hypothesis upon the subject. It breaks down, however, when we attempt to calculate what the amount of the contraction might be, on the supposition that it is well founded: only a very small portion of the contraction could be thus accounted for. I regret that I cannot now conveniently refer to Guillaume's interesting demonstration of this result.

Prof. Young has placed on record an experiment with three thermometers, which he heated to 280° C. The zero movement, however, only ranged from 1° to 1°·2,—small readings which might very possibly have been obtained, or not, on either of the thermometers at other times. It is consequently very difficult to draw any inference from this experiment. I may, however, mention that closed thermometers made of lead glass are very apt to show a rise of zero after heating to about 120° C. and upwards to some temperature in the neighbourhood of 270° C., and after that a descent of zero; the temperature of 280° C. would in that case be an unsatisfactory one for a test experiment, and the effect of plasticity might very possibly be masked. On the other hand, if the three thermometers were of hard glass, all the zero movements would in that case be greatly diminished, and the results would be in less bold relief.

I do not know any substance more curious or interesting in its properties than glass; and I should be glad if Prof. Young—into whose able hands the matter has fallen—could decisively test my suggestion that plasticity is the main cause of the zero ascent after 120° C. Probably it has little or nothing to do with the ascent at the ordinary temperature. It is, however, known that fine threads of glass are undoubtedly plastic at the ordinary temperature.

EDMUND J. MILLS.

Melrose, N.B., December 29, 1889.

THE PALÆONTOLOGICAL EVIDENCE FOR THE TRANSMISSION OF ACQUIRED CHARACTERS.[1]

MUCH of the evidence brought forward in France and Germany in support of the transmission of acquired characters, which has been so ably criticized in Weismann's recent essays, is of a very different order from that forming the main position of the so-called Neo-Lamarckians in America. It is true that most American zoologists, somewhat upon Semper's lines, have supported the theory of the direct action of environment, always assuming, however, the question of transmission. But Cope, the able if somewhat extreme advocate of these views, with Hyatt, Ryder, Brooks, Dall, and others, holding that the survival of the fittest is now amply demonstrated, submit that, in our present need of an explanation of the origin of the fittest, the principle of selection is inadequate, and have brought forward and discussed the evidence for the inherited modifications produced by reactions in the organism itself—in other words, the indirect action of environment. The supposed arguments from pathology and mutilations have not been considered at all: these would involve the immediate inheritance of characters impressed upon the organism and not springing from internal reactions, and thus differ both in the element of time and in their essential principle from the above. As the selection principle is allowed all that Darwin claimed for it in his later writings, this school stands for Lamarckism *plus*—not *versus*—Darwinism, as Lankester has recently put it. There is naturally a diversity of opinion as to how far each of these principles is operative, not that they conflict.

The following views are adopted from those held by Cope and others, so far as they conform to my own observations and apply to the class of variations which come within the range of palæontological evidence. In the life of the individual, adaptation is increased by local and general metatrophic changes, of necessity correlated, which take place most rapidly in the regions of least perfect adaptation, since here the reactions are greatest; the main trend of variation is determined by the slow transmission, not of the full increase of adaptation, but of the disposition to adaptive atrophy or hypertrophy at certain points; the variations thus transmitted are accumulated by the selection of the individuals in which they are most marked and by the extinction of inadaptive varieties or species: selection is thus of the *ensemble* of new and modified characters. Finally, there is sufficient palæontological and morphological evidence that acquired characters, in the above limited sense, are transmitted.

In the present state of discussion, everything turns upon the last proposition. While we freely admit that transmission has been generally assumed, a mass of direct evidence for this assumption has nevertheless been accumulating, chiefly in the field of palæontology. This has evidently not reached Prof. Weismann, for no one could show a fairer controversial spirit, when he states repeatedly: "Not a single fact hitherto brought forward can be accepted as proof of the assumption." It is, of course, possible for a number of writers to fall together into a false line of reasoning from certain facts; it must, however, be pointed out that we are now deciding between two alternatives only, viz. pure selection, and selection *plus* transmission.

The distinctive feature of our rich palæontological evidence is that it covers the entire pedigree of variations: we are present not only at but before birth, so to speak. Among many examples, I shall select here only a single illustration from the mammalian series—the evolution of the molar teeth associated with the peculiar evolution of the feet in the horses. The feet, starting with plantigrade bear-like forms, present a continous series of readjustments of the twenty-six original elements to digitigradism which furnish proof sufficient to the Lamarckian. But, as selectionists would explain this complex development and reduction by panmixia and the selection of favourable fortuitous correlations of elements already present, the teeth render us more direct service in this discussion, since they furnish not only the most intricate correlations and readjustments, but the complete history of the addition

[1] This article is an informal reply to the position taken by Prof. Weismann in his essays upon heredity. I have borrowed freely from the materials of Cope, Ryder, and others, without thinking it necessary to give acknowledgment in each case.

of a number of entirely new elements—*the rise of useful structures from their minute embryonic, apparently useless, condition*, the most vulnerable point in the pure selection theory. Here are opportunities we have never enjoyed before in the study of the variation problem.

The first undoubted ancestor of the horse is *Hyracotherium;* let us look back into the early history of its multicuspid upper molars, every step of which is now known. Upon the probability that mammalian teeth were developed from the reptilian type, Cope predicted in 1871 that the first accessory cusps would be found on the anterior and posterior slopes of a single cone, *i.e.* at the points of interference of an isognathous series in closing the jaws. Much later I showed that precisely this condition is filled in the unique molars of the Upper Triassic *Dromotherium*. These with the main cusp form the three elements of the tritubercular crown. Passing by several well-known stages, we reach one in which the heel of the lower molars intersects, and, by wearing, produces depressions in the transverse ridges of the upper molars. At these points are developed the intermediate tubercles which play so important a *rôle* in the history of the Ungulate molars. So, without a doubt, every one of the five main component cusps superadded to the original cones, is first prophesied by a point of extreme wear, replaced by a minute tubercle, and grows into a cusp. The most worn teeth, *i.e.* the first true molars, are those in which these processes take place most rapidly. We compare hundreds of specimens of related species; everywhere we find the same variations at the same stages, differing only in size, never in position. We extend the comparison to a widely separate phylum, and find the same pattern in a similar process of evolution. Excepting in two or three side lines the teeth of all the Mammalia have passed through closely parallel early stages of evolution, enabling us to formulate a law: *The new main elements of the crown make their appearance at the first points of contact and chief points of wear of the teeth in preceding periods.* Whatever may be true of spontaneous variations in other parts of the organism, these new cusps arise in the perfectly definite lines of growth. Now, upon the hypothesis that the modifications induced in the organism by use and disuse have no directive influence upon variations, all these instances of sequence must be considered coincidences. If there is no causal relationship, what other meaning can this sequence have? Even if useful new adjustments of elements already existing may arise independently of use, why should the origin of new elements conform to this law? Granting the possibility that the struggle for existence is so intense that a minute new cusp will be selected if it happens to arise at the right point, where are the non-selected new elements, the experimental failures of Nature? We do not find them. Palæontology has, indeed, nothing to say upon individual selection, but chapters upon unsuccessful species and genera. Here is a practical confirmation of many of the most forcible theoretical objections which have been urged against the selection theory.

Now, after observing these principles operating in the teeth, look at the question enlarged by the evolution of parallel species of the horse series in America and Europe, and add to the development of the teeth what is observed in progress in the feet. Here is the problem of correlation in a stronger form even than that presented by Spencer and Romanes. To vary the mode of statement, what must be assumed in the strict application of the selection theory? (*a*) that variations in the lower molars correlated with coincident variations of reversed patterns in the upper molars, these with metamorphoses in the premolars and pocketing of the incisor enamel; (*b*) all new elements and forms at first so minute as to be barely visible immediately selected and accumulated; (*c*) in the same individuals favourable variations in the proportions of the digits involving readjustments in the entire limbs and skeleton, all coincident with those in the teeth; (*d*) finally, all the above new variations, correlations and readjustments, not found in the hereditary germ-plasm of one period, but arising fortuitously by the union of different strains, observed to occur simultaneously and to be selected at the same rate in the species of the Rocky Mountains, the Thames Valley, and Switzerland! These assumptions, if anything, are understated. Any one of them seems to introduce the element of the inconstant, whereas in the marvellous parallelism, even to minute teeth markings and osteological characters, in all the widely distributed forms between *Hyracotherium* and *Equus*, the most striking feature is the constant. Viewed as a whole, this evolution is one of uniform and uninterrupted progression, taking place simultaneously in all the details of structure over great areas. So nearly does race adaptation seem to conform to the laws of progressive adaptation in the individual, that, endowing the teeth with the power of immediate reactive growth like that of the skeleton, we can conceive the transformation of a single individual from the Eocene five-toed bunodont into the modern horse.

The special application of the Lamarckian theory to the evolution of the teeth is not without its difficulties, some of which have been pointed out to me by Mr. E. B. Poulton. To the objection that the teeth are formed before piercing the gum, and the wear produces a loss of tissue, it may be replied that it is not the growth, but the reaction which produces it, which is supposed to be transmitted. Again, this is said to prove too much; why is the growth of these cusps not continuous? This may be met in several ways: first, in the organism itself these reactions are least in the best adapted structures, a proposition which is more readily demonstrated in the feet than in the teeth—moreover, since the resulting growth never exceeds the uses of the individual, there is a natural limit to its transmission; secondly, the growth of the molars is limited by the nutritive supply—we observe one tooth or part growing at the expense of another; third, in some phyla we do observe growth which appears to lead to inadaptation and is followed by extinction. In one instance we observe the recession of one cusp taking place *pari passu* with the development of the one opposed to it. These and many more general objections may be removed later, but they are of such force that, even granting our own premises, we cannot now claim to offer a perfectly satisfactory explanation of all the facts.

The evidence in this field for, is still much stronger than that against, this theory. To sum up, the new variations in the skeleton and teeth of the fossil series are observed to have a definite direction; in seeking an explanation of this direction, we observe that it universally conforms to the reactions produced in the individual by the laws of growth; we infer that these reactions are transmitted. If the individual is the mere pendent of a chain (Galton), or upshoot from the continuous root of ancestral plasm (Weismann), we are left at present with no explanation of this well-observed definite direction. But how can this transmission take place? If, from the evident necessity of a working theory of heredity, the *onus probandi* falls upon the Lamarckian—if it be demonstrated that this transmission does not take place—then we are driven to the necessity of postulating some as yet unknown factor in evolution to explain these purposive or directive laws in variation, for, in this field at least, the old view of the random introduction and selection of new characters must be abandoned, not only upon theoretical grounds, but upon actual observation.

Reading between the lines of Weismann's deeply interesting essays, it is evident that he himself is coming to this conclusion. HENRY FAIRFIELD OSBORN.

Princeton College, August 23.

A FIELD LAID DOWN TO PERMANENT GRASS.

A VALUABLE paper, by Sir J. B. Lawes, on the history of a field laid down to permanent grass, has been reprinted, by Messrs. Spottiswoode, from the Journal of the Royal Agricultural Society of England. The field in question forms part of the Rothamsted estate, and was laid down to permanent grass nearly thirty years ago, by Dr. Gilbert, to whom it was let in 1856. It has been mown for hay every year from the commencement; and in the present pamphlet Sir J. B. Lawes gives full particulars as to the economical results, the constituents supplied in the manures and removed in the crops, the changes within the soil in the formation of the meadow, and the botany of the meadow. The following are his summary and general conclusions:—

(1) By the judicious employment of manures, both natural and artificial, arable land has been converted into permanent grass, not only without loss, but with some profit to the tenant.

(2) The important constituents, nitrogen and phosphoric acid, were supplied in the manures in larger quantities than they were removed in the crops; but potash in only about the same quantity as it was removed.

(3) The application of dung, not only compensates for much of the exhaustion from the removal of hay, but it has a beneficial influence on the botanical character of the herbage.

(4) Although the grass has been mown every year for nearly thirty years, there has been a considerable accumulation of fertility within the soil.

(5) Analysis has shown that there has been an increase of nitrogen in the surface-soil, beyond that which could be explained by excess supplied in manure over that removed in crops, and by the combined nitrogen coming down in rain, and the minor deposits from the atmosphere. Part, if not the whole, of this increase is probably derived from the subsoil by deeply-rooted plants, which afterwards leave a nitrogenous residue within the surface-soil. Or, possibly, some of it may have its source in the free nitrogen of the atmosphere, brought into combination within the soil, under the influence of micro-organisms, or other low forms.

(6) In laying down arable land to permanent grass, especially if hay is to be removed, it is essential to supply, not only nitrogenous, but an abundance of mineral manures, and especially of potash, a large quantity of which is removed in the crops, and must be returned. When the grass is not mown, but fed, the exhaustion is much less, but it is greater when consumed for the production of milk than when for that of store or fattening increase.

THE TOTAL ECLIPSE OF DECEMBER 22.

MISFORTUNE has attended the double expedition sent by the Royal Astronomical Society to observe the total eclipse of December 22. In Africa observations were made impossible by bad weather. Observations were secured off the coast of French Guiana, but at a cost which is deeply to be deplored—the death of Father Perry.

The telegram received from Demerara is as follows:—"104 corona American Perry dead dysentery." With regard to the part of this telegram which needs explanation, the *Times* of January 6 says:—"104 is resolvable into the factors 2, 4, and 13, of which the first number means that the weather was only moderately good; the second that successful exposures were made with the Abney 4-inch lens, but that the development was not carried out, owing either to unfavourable climatic conditions, or possibly to the illness of Father Perry; and the third, that successful photographs were obtained with the 20-inch mirror, but again the development was not completed. The words corona American signify most probably that the corona was of the same form as that seen on January 1, 1889, when a total eclipse was successfully observed in California, and the form was then that now generally ascribed to a period of minimum sun-spots, elongated at the sun's equator and radial but short at the poles."

NOTES.

THE list of those who received New Year's honours and appointments included Brigade-Surgeon George King, F.R.S., Bengal Medical Service, Superintendent of the Royal Botanical Gardens, Calcutta. He has been made Companion of the most eminent order of the Indian Empire.

THE seventy-second anniversary of the Institution of Civil Engineers occurred last Thursday, when a revised list of the members of all classes showed that the numbers on the books amounted to 5904, representing an increase of 3½ per cent. in the past twelve months.

THE Institution of Electrical Engineers will hold the first meeting of the current term this evening, when the President, Dr. John Hopkinson, F.R.S., will deliver his inaugural address.

THE annual general meeting of the Royal Meteorological Society will be held at 25 Great George Street, Westminster, on Wednesday, the 15th inst., at 7.15 p.m., when the Report of the Council will be read, the election of Officers and Council for the ensuing year will take place, and the President (Dr. W. Marcet, F.R.S.) will deliver an address on "Atmospheric Dust," which will be illustrated by a number of lantern slides.

THE *Mining Journal* is to be congratulated on the very admirable portait of Dr. Archibald Geikie which appeared in its issue of December 28. The portrait was accompanied by a short but very good account of Dr. Geikie's life and labours.

DR. RAOUL GAUTIER has been appointed Professor of Astronomy at the University of Geneva, and has at the same time been made director of the Observatory. His father, Colonel E. Gautier, retains his connection with the latter establishment, with the title of honorary director.

THE Professorship of Agriculture and Rural Economy at the Royal Agricultural College, Cirencester, vacant by the resignation of Prof. McCracken, has been conferred upon an old student and gold medallist of the College, Mr. James Muir.

THE arrangements of the Royal Botanic Society for 1890 include exhibitions of spring flowers on March 26 and April 23; summer exhibitions of plants, flowers, and fruit, on May 14 and June 11; and an evening *fête* and exhibition on July 2. Botanical lectures will be given on May 9, 16, 23, and 30, and on June 6 and 13. These lectures will be free to all visitors in the Gardens.

ON Thursday, January 16, Prof. R. Meldola, F.R.S., will begin a course of twelve special evening lectures at the Finsbury Technical College, on coal-tar products. The object of the course is to describe the technology of the raw materials manufactured from the tar. The theoretical treatment will serve as a general introduction to the chemistry of the aromatic compounds. A syllabus can be had on application to the College.

In May next, the six hundredth anniversary of the foundation of the University of Montpellier will be celebrated.

M. Cosson, member of the French Academy of Sciences, and the author of many memoirs on the flora of Algeria and Tunis, died a few days ago in Paris, and was buried on the 4th inst.

We review to-day the volumes which conclude the series of Reports on the zoological results of the *Challenger* Expedition. In a prefatory note introducing Vol. II. of the Report on Physics and Chemistry, just issued, Dr. Murray explains that with the exception of a volume on deep-sea deposits, which will be issued in March next, and a summary volume, which, it is hoped, may be finished in about a year thereafter, the entire series of Reports is now completed. These Reports have been issued at intervals during the last nine years, whenever ready, and without any reference to systematic arrangement. They are bound up in forty-seven large quarto volumes, containing 27,650 pages of letterpress, 2662 lithographic and chromo-lithographic plates, 413 maps, charts, and diagrams, together with a great many woodcuts.

Some time ago Mr. J. T. Cunningham, Naturalist at the Plymouth Marine Biological Laboratory, wrote to the *Times* about the occurrence of anchovies on the south coast of England. In another letter, printed in the *Times* on Wednesday, he has given some fresh information about the matter. From Mr. Whitehead, of Torquay, he learns that the sprat fishermen at that place were catching a number of anchovies in their sprat nets together with sprats; that about a fifth of their catches consisted of anchovies. Mr. Dunn has sent him specimens from Megavissey. These were caught, as it were, accidentally in pilchard nets. Mr. Cunningham has made inquiries among the pilchard and herring fishermen at Plymouth, and finds that almost every time they shoot their nets they catch a few anchovies—from one to a dozen. The mesh of a pilchard net is much too large to hold an anchovy, and these occasional specimens are caught only in parts of the nets that get entangled; they are not meshed in the ordinary way. Of the anchovies he has obtained from the pilchard fishermen, he says there is no doubt whatever as to their being of the same species (*Engraulis encrasicholus*) as those which we import from France and Italy.

A rather serious subsidence has occurred near Dane Bridge, Northwich. A large hole, nearly 10 feet deep and covering a space of 50 feet by 30 feet, has been formed near the roadway. The Bridge Inn is now 24 inches out of the perpendicular, or some 5 inches more than it was before the subsidence. The inn had been securely bolted and the walls secured some time since, otherwise it would probably have collapsed. Some wooden structures standing on the opposite side of the road have been rendered untenantable. The gas and water mains were dislocated, and had to be repaired by the local board.

The General Report of the Survey of India Department for 1887-88, which has recently been published, indicates a gradual increase in the annual amount of work done. The triangulation along the Madras Coast has been extended 370 miles in length; and similar operations have been conducted in Baluchistan, one series along a parallel of 30° N., and another along the meridian of 67° E., both meeting at Quetta and having an aggregate length of 270 miles. The topographical surveys during the year covered an area of 15,673 square miles. It is gratifying to note that the system, started in the previous year, of employing the village *patwáris* as cadastral surveyors has been continued with very encouraging results, the aggregate area surveyed cadastrally being 5435 square miles. The special telegraphic longitude operations were resumed, and 7 arcs of longitude in Southern India measured, with the particularly interesting result of indicating an excess of gravitation toward the ocean surrounding India. Geographical surveys in Burmah have been made on a large scale, the Ruby Mine tract receiving special attention. A valuable addition to our knowledge of Afghanistan is furnished by the report of Yusuf Sharif, who accompanied the Afghan Boundary Commission, and succeeded in surveying 4600 miles of new country on his return. The statistics of the output of maps and reproductions at the principal offices show a marked increase. The value of the Dehra Dun station for purposes of solar photography is forcibly demonstrated by the fact that photographs of the sun were obtained on no less than 327 days, and forwarded to the Solar Physics Committee, to complete the Greenwich series. The Report is accompanied by the usual maps and narratives of the various expeditions.

We owe a new and interesting application of photography to M. Bertillon, the well-known director of the Identification Department at the Paris Prefecture of Police. M. Bertillon has been devoting himself for some months to the study of the physical peculiarities engendered by the pursuit of different occupations. The police have frequently to deal with portions of bodies, and it would greatly aid their investigations to be able to determine the calling of the murdered person in each particular case. The hand is as a rule the part naturally most affected by the occupation, and M. Bertillon has taken a very large series of photographs, each one showing on a large scale the hands, on a smaller scale the whole figure of the workman at his work, so that one may see at a glance the position of the body, and which are the parts that undergo friction from the tools in use. From the hands of the navvy all the secondary lines disappear, and a peculiar callosity is developed where the spade handle rubs against the hand; the hands of tin-plate workers are covered with little crevasses produced by the acids employed; the hands of lace-makers are smooth, but they have blisters full of serum on the back and callosities on the front part of the shoulder, due to the friction of the straps of the loom; the thumb and the first joints of the index of metal-workers show very large blisters, whilst the left hand has scars made by the sharp fragments of metal. Experts in forensic medicine (Vernois among others) have before drawn attention to the subject, but this is the first time that an investigation has been carried out on a large scale, and in M. Bertillon's hands it should lead to the best results.

Shocks of earthquakes continue to be felt in the province of Semiryetchensk, Russian Turkestan. After September 12, they were felt nearly every day, the most severe shocks having been experienced on September 17, at 11.45 a.m.; on the 22nd, at 1.15 p.m.; on the 23rd, at 4.55 a.m. On September 30, at 6.30 p.m., there was a particularly severe shock, preceded by a loud underground noise.

Severe shocks of earthquake were felt on the northern and north-eastern shores of Lake Issyk-kul nearly every day from November 19 to December 5. Many chimney-pots in several villages were destroyed by the shock of November 19.

The latest information as to the earthquake which visited Lake Issyk-kul on July 12 is given in the *Akmolinsk Gazette*. It lasted from 3.15 to 3.30 a.m., and destroyed, or rendered uninhabitable, all buildings in the villages Uital, Sazanova, Preobrajensk, and Teplyi Klutch, of the Issyk-kul district. Eight persons were killed, and 43 injured, some of them severely. The greatest disasters, however, appear to have occurred among the Kirghizes, who camped in the Kunghei Alatau, on the northern shore of Lake Issyk-kul. They had no fewer than 26 killed and 15 injured. The numbers of cattle killed during the earthquake were: 283 horses, 75 horned cattle, and 379 sheep. Several villages of the district

of Vyernyi also suffered very much. At Przevalsk (formerly Karakol, on the southern shore) and the surrounding villages many houses were destroyed; while amidst the Taranchis of the district of Vyernyi 21 persons were killed and 2 severely injured. At Vyernyi itself (50 miles north of the lake) the earthquake was relatively feeble; but at Jarkend all houses were rendered uninhabitable. In the west of Lake Issyk-kul the shocks were feeble, but in the north the wave of the earthquake spread as far as Kopal (180 miles from Issyk-kul, as the crow flies), and even as far as Sergiopol, which is 380 miles distant from the northern shore of the lake.

THE Council of the Italian Meteorological Society, publishes an *Annuario Meteorologico*, in which will be found much useful information for general readers. The volume for 1890 contains 276 small octavo pages, and is divided into four parts:—(1) Ephemerides and astronomical tables. This part also contains a special appendix giving the concordance of the calendars and other particulars of the 17 eastern nations. (2) Tables for the reduction of meteorological observations, by Padre Denza, with useful examples of how the corrections are applied, and also meteorological and magnetical statistics. (3) Geographical and topographical elements, together with an instructive paper on recent electrical terms and measurements. (4) A series of short articles on various sciences, among which we may specially mention one by Padre Denza, on the mode of determining the meridian line and time, for the use of observers who have only simple instruments. The most recent ideas upon the formation of hail, by Prof. L. Bombicci. On the types of isobars which favour frosts, by Prof. P. Busin, with suggestions for any observers willing to work at this subject. And, on the cause of earthquakes, in which the various theories are discussed, by Dr. C. De Giorgi.

THE Deutsche Seewarte has published, in a separate memoir, the results of the meteorological observations taken at its nine coast stations for the two lustra 1876–80 and 1881–85, together with summaries for the whole decade. The work contains very useful information relating to the climate of Northern Germany, and the hope is expressed that other institutions will publish similar results for their respective systems. In *Symons's Monthly Meteorological Magazine* for November it is pointed out that the years begin with December, in opposition to the regulations of the Vienna Congress that the years should begin with January, and an explanation of this is asked for. The explanation is given in the introduction: by this method the Seewarte has been able to give seasonal means, as well as monthly means. The December observations, which precede those for January, are for the same year as all the other months, not for the preceding year. The greatest annual range of temperature is 107°·1 at Neufahrwasser. The greatest daily rainfall occurred at Hamburg—viz. 3·37 inches. The annual percentage of rainy days varies from 41·6 to 59·7.

THE Annual Report of the Chief Signal Officer of the United States, for the year 1889, sets forth the extended and important character of the meteorological work that is carried on. Apart from weather forecasts, and storm warnings, the duties include the gauging and reporting of rivers, the reporting of temperature and rainfall conditions for the cotton interests, frost warnings in the interest of agriculture, and the notification of advancing cold waves for the benefit of the general public. The Chief Signal Officer estimates that the gratuitous distribution of meteorological data in the United States in a single week is greater than in all Europe in the entire year. The weather forecasts are issued twice daily, at 8 a.m. and 8 p.m., for a period of twenty-four hours, and the percentage of success shows a general average of 81. The present system of flag signals gives clear and definite information as to whether a storm is to be light or severe, whether its centre is approaching or has passed the station, and from what quarter high winds are expected. With regard to scientific researches, systematic observations of atmospheric electricity have been made, to determine whether these could be made use of in weather forecasting, the result being that negative electricity may be observed without being in any way related to precipitation, past, present, or future, and that such observations do not promise to be of practical use. Prof. C. Abbe has prepared a popular and non-mathematical exposition of the laws of storms, with a view to their better prediction. The Chief Signal Officer states that the Report brings together many new results, and that Prof. Abbe finds the source and maintaining power of a storm in the absorption by the cloud of solar heat, and in the liberation of heat in the cloud by those particles that subsequently fall to the ground as rain or snow, and endeavours to show that the movement of the storm centre is principally influenced by the location and amount of such precipitation.

REMARKABLE electrical phenomena are witnessed at the new observatory on the steep and isolated Säntis (8215) in Northern Switzerland. Thunderstorms are extremely frequent; thus in June and July last year, only three days were without them. As a rule, thunder peals from midday till evening. The noise is short, partly owing to shortness of flashes and partly to the small amount of echo. The thunderstorms come on quite suddenly, in a clear sky. One of the surest indications of their approach is the bristling of the observer's hair. During hail, the iron rods of the house give a hissing sound, associated with luminous effects.

M. E. HOSPITALIER, the electrician, has begun the publication of a work in two volumes, entitled "Traité Elémentaire de l'Energie électrique." The first volume, comprising the definition, principles, and general laws, has been issued. Vol. II., on industrial applications, will be issued during the present year.

IN the current number of the *American Naturalist* Mr. Clement L. Webster gives an interesting account of various "mound-builder mounds" near Old Chickasaw, Iowa. Speaking of three human skeletons found in one of these mounds, the writer says that the crania show "an extremely low grade of mental development." They are smaller than the Neanderthal skull.

M. VAYSSIÈRE has published the second part of his monograph of the Opisthobranchiate Mollusca of the Gulf of Marseilles. It contains many fine plates.

THE origin of the very extensive pampas-formation in South America, a humus-covered loess of fine dust-like material, from 100 to 160 feet thick, with limestone concretions, and numerous fine passages, has attracted the attention of several geologists. From an important recent contribution to the subject by Roth (German Geological Society), it would appear that wind, river, lagoon, and coast deposits may all be distinguished in the pampas. The coast deposits are chiefly recognized by sand and marine shells. The lagoon formations are darker in colour and of small extent and thickness. The deposits from rivers are either from those rising in the mountains, or from those rising in the pampas themselves. The former contain, near the mountains, blocks of stone rolled down, and the granular nature of the deposit grows ever finer in the course of the rivers, which lose themselves in the pampas, in a region rich in lagoons, with a pretty abundant vegetation under recurrent rains. The deposits from the poor streams rising in the pampas have round, smooth, lime concretions, with smooth bone fragments of mammals. But most extensive are the æolic or air formations, of which the vertical root-like tubes and irregularly-formed lime concretions are characteristic. Violent winds carry the fine water-deposited

material in all directions over the plains till vegetation comes and retains it. The uniform character of the pampas loess arises, according to Roth, not from the material and mode of deposition, but chiefly from its transformation under the influence of vegetation. The roots taking up the matters they need, decompose the soil, and the humus arising from the decay of the plants acts on the new material spread over the surface by wind and rain, along with fresh plants, by way of decomposition. A further metamorphosis occurs by water carrying down matter through the porous layers, with the result of new combinations, and a harder, more compact loess in the lower parts. From observations of marine Tertiary beds of (probably) Miocene age in Entre Rios, over typical pampas loess, Roth infers that the formation of loess began some time in the Eocene period; in diluvial times it grew in intensity, and has gone on till now without interruption.

An interesting study has been lately made by Herr Tarchenoff (*Pflüger's Archiv*) of electric currents in the skin from mental excitation. Unpolarizable clay-electrodes, connected with a delicate galvanometer, were applied to various parts—hands, fingers, feet, toes, nose, ear, and back; and, after compensation of any currents which occurred during rest, the effects of mental stimulation were noted. Light tickling with a brush causes, after a few seconds' period of latency, a gradually increasing strong deflection. Hot water has a like effect; cold, or the pain from a needle-prick, a less. Sound, light, taste, and smell stimuli act similarly. If the eyes have been closed some time, mere opening of them causes a considerable deflection from the skin of the hand. Different colours here acted unequally. It is remarkable that these skin-currents also arise when the sensations are merely imagined. One vividly imagines, *e.g.*, he is suffering intense heat, and a strong current occurs, which goes down when the idea of cold is substituted. Mental effort produces currents varying with its amount. Thus, multiplication of small figures gives hardly any current; that of large, a strong one. If a person is in tense expectation, the galvanometer mirror makes irregular oscillations. When the electrodes are on hand or arm, a voluntary movement, such as contraction of a toe or convergence of the eyes, gives a strong current. In all the experiments it appeared that, with equal nerve excitation, the strength of the skin-currents depended on the degree to which the part of the skin bearing the electrodes was furnished with sweat-glands. Thus some parts of the back, and upper leg and arm, having few of these, gave hardly any current. Herr Tarchenoff considers that the course of nearly every kind of nerve-activity is accompanied by increased action of the skin-glands. Every nerve-function, it is known, causes a rise of temperature, and accumulation of the products of exchange of material in the body. Increase of sweat-excretion favours cooling, and the getting rid of those products.

A meteorite of special interest to chemists has been examined by M. Stanislas Meunier. It fell at Mighei, in Russia, on June 9, 1889, and it was evident, from a cursory inspection, that it was of a carbonaceous nature. In external appearance it exhibited a deep greenish-black colour, relieved by numerous small brilliant white crystals; the surface was considerably wrinkled, and blown out into swellings. The material was very friable, and readily soiled the fingers. A section under the microscope was observed to consist largely of opaque matter interspersed with crystals of a magnesian pyroxene and peridote. Fine particles of metallic iron and nickeliferous iron were readily collected by a magnet from the powdered rock, having all the characteristics of meteoric iron. The density of the meteorite was not very high, 2·495. About 85 per cent. of the rock was found to be attacked by acids, the portion so attacked being shown by analysis to consist mainly of a silicate of magnesium and iron having the composition of peridote. On the remaining 15 per cent. being heated in a current of dry oxygen gas, it readily took fire and burnt brilliantly. The products of combustion, which were allowed to pass through the usual absorption tubes containing pumice and sulphuric acid and potash, showed that the meteorite contained nearly 5 per cent of organic matter. In order to obtain some idea as to the nature of the carbonaceous substance present, a quantity of the rock was powdered and then digested with alcohol; on evaporation the alcoholic extract yielded a bright yellow resin, which was readily precipitated from the alcoholic solution by water, and much resembled the kabäite of Wöhler. The most curious chemical properties of the meteorite, however, are exhibited with a cold aqueous extract of the powdered rock. The filtered liquid is quite colourless, but exhales a faint odour due to an organic salt which carbonizes on evaporation to dryness, and may be burnt upon platinum foil. The aqueous extract further contains nearly 2 per cent. of mineral matter possessing properties of a novel character. Barium chloride solution gives a heavy white precipitate, which, however, is not barium sulphate. Silver nitrate gives a voluminous curdy reddish-violet precipitate, reminding one of silver chromate, but of quite a distinct and peculiar tint, and which blackens in a very few minutes in daylight. The substance which exhibits these reactions is unchanged by evaporation to dryness and ignition to redness, readily dissolving in water again on cooling and giving the above reactions. The silver nitrate precipitate, when allowed to stand for some time undisturbed in the liquid, becomes converted into colourless but brilliantly refractive crystals, which polarize brightly between crossed Nicols under the microscope, and which are insoluble in boiling water. The properties of this new substance contained in the water extract appear to approximate most closely to those of certain metallic tellurates, but the new compound appears also to differ in certain respects from those terrestrial salts.

The additions to the Zoological Society's Gardens during the past week include a Brown Capuchin (*Cebus fatuellus* ♂) from Guiana, presented by J. H. Bostock; a Common Gull (*Larus canus*), a Black-headed Gull (*Larus ridibundus*), British, presented by Mr. E. Keilich; two Schlegel's Doves (*Chalcopelia puella*) from West Africa, presented by Major C. M. MacDonald; a Common Barn Owl (*Strix flammea*), British, presented by Mr. H. Craig; two Swainson's Lorikeets (*Trichoglossus novæ-hollandiæ*) from Australia, deposited.

OUR ASTRONOMICAL COLUMN.

Objects for the Spectroscope.

Sidereal Time at Greenwich at 10 p.m., January 9 = 5h. 17m. 32s.

Name.	Mag.	Colour.	R.A. 1890.	Decl. 1890.
			h. m. s.	° ′
(1) Nebula in Orion ...	—	Greenish.	5 29 52	− 5 29
(2) 20 Leporis U.A. ...	6	Reddish-yellow.	5 6 14	−11 59
(3) *η* Orionis	4	Whitish-yellow.	5 19 0	− 2 30
(4) *β* Tauri	2	White.	5 19 18	+28 31
(5) 99 Birm.	8	Reddish-yellow.	5 4 25	− 5 38
(6) U Canis Minoris ...	Var.	Reddish?	7 35 22	+ 8 38
(7) T Arietis	Var.	Yellow.	2 42 11	+17 3

Remarks.

(1) The bright lines so far recorded in the visible part of the spectrum of the Great Nebula in Orion are as follows:—

Wave-lengths.		Observers.
5872 (D_3)	...	Dr. Copeland.
559	...	Mr. Taylor.
520	...	,,
500	...	Dr. Huggins.
495	...	,,
486 (F)	...	,,
470	...	Mr. Taylor.
447	...	Dr. Copeland.
434 (G)	...	Dr. Huggins.

The principal line in the photographic spectrum is near wave-length 373, and this seems to be special to certain parts of the nebula, according to Dr. Huggins's researches.

Although so much admirable work has already been done, there is still abundant scope for further investigations. One of the chief points requiring attention at present is the character of the brightest line, near λ 500. Researches on the spectra of meteorites, coupled with previous records of the line as having a fringe on its more refrangible side, led Prof. Lockyer to suggest, in 1887, that it was the remnant of the fluting near λ 500 seen in the spectrum of burning magnesium. Observations have since been made by Prof. Lockyer, Mr. Taylor, and myself, and all agree that the line is not sharp on the more refrangible side. Further observations are suggested. High dispersion is not necessary, or indeed desirable.

Direct comparisons of the chief nebula line with the magnesium fluting are also required, but this is an observation of great delicacy, requiring high dispersion. It must also be demonstrated that under the same conditions of comparison the F line of hydrogen is coincident with the third nebula line.

It has been suggested that the line near 559 recorded by Mr. Taylor is the remnant of the brightest manganese fluting; this can only be decided by direct comparisons.

In my own observations I noted that the F line is not seen in all parts of the nebula, and in this respect it resembles the ultra-violet line. This localization of the lines opens up a new field of work.

(2) This is one of the finest examples of stars of Group II. The bands 1 to 9 are perfectly well seen, but there is no record of the presence or absence of line absorptions. Observations of the carbon flutings are suggested, a spirit-lamp flame being convenient for comparisons. The two flutings to be examined, both for position and compound structure, are those near λ 517 and 474. The latter is a group of five flutings, extending from about λ 468 to λ 474, and under some conditions the point of maximum brightness of the group is shifted from 474 to 468. Comparisons of bands 4 and 5 with the brightest flutings of manganese and lead should also be made.

(3) This is a star with a spectrum of the solar type, of which the usual differential observations are required. The relative thicknesses of the hydrogen and other lines should also be noted.

(4) Gothard describes this star as belonging to Group IV. The usual observations are required.

(5) This is a star of Group VI., in which band 9 is dark, and band 6 pale. Dunér does not record any of the secondary bands. These and absorption lines should be looked for.

(6) This variable has a period of 423 days, and ranges from 8·5 at maximum to 13·5 at minimum (Gore). The spectrum has not yet been recorded. Maximum on January 9.

(7) This is a variable with a spectrum of the Group II. type. The period is 324 days, and the magnitude varies from about 8 at maximum to 9·5 at minimum. The maximum will not occur until January 17, but observations for the bright lines of hydrogen, &c., may be commenced at once. Variations of the widths and intensities of the bands before and after maximum may also be looked for. A. FOWLER.

IDENTITY OF COMET VICO (1844) WITH BROOKS'S (1889).—In a note on some comets of short period (*Bulletin Astronomique*, November 1889), M. L. Schulhof observes that a comparison of the elements of Vico's comet (1844) given by Le Verrier with those of Brooks's comet (1889) shows a striking similarity. According to Mr. Chandler (*Astronomical Journal*, No. 205), Brooks's comet in May 1886 was at a distance 0·064 from Jupiter, and in heliocentric longitude 185°, whilst Vico's comet found itself about 1885–86, according to the elements of M. Brünnow in heliocentric longitude 162°, and approximately 0·4 from Jupiter. M. Schulhof adds, however, that the only objection to the hypothesis is that the action of Jupiter at a distance 0·4 would hardly have been sufficient to change so considerably the perihelion distance and the time of revolution. It will be sufficient to calculate back the perturbations of Brooks's comet as far as 1885 to definitely settle this question.

An investigation of the elements of Comets Lexell and Finlay has led to the conclusion that they are not identical, but the results found are not to be taken as conclusive, a farther and more exact determination of the elements of Finlay's comet having been undertaken.

OBSERVATIONS OF SOME SUSPECTED VARIABLES.—Observations of Lalande 26980 = 14h. 42·7m. + 6° 28′·9 (1875), be Rev. John G. Hagen, of Georgetown College, give the negativy result that there is no proof of variation between the years 1884–89, and although an average of 15 observations a year have been made, the extreme range of magnitude is less than 0·2.

Three stars were found that showed rather a large difference from the Bonn D.M. magnitudes, and were watched from 1886 to 1889. No variation, however, was noticed during these three years. The following are the three stars and the magnitudes found compared with Argelander's :—

		m.	m.	m.
D.M. 55°2587	...	7·8 ± 0·1 ;	D.M.	= 8·8.
D.M. 44°3368	...	7·6 ± 0·1 ;	D.M.	= 7·0.
D.M. 44°3402	...	7·7 ± 0·0 ;	D.M.	= 8·1.

SPECTRUM OF A METALLIC PROMINENCE.—Prof. Vogel in a letter to Prof. Tacchini (*Mem. Società Spettroscopisti Italiani*, November 1889) observes that the positions of the lines measured in a metallic prominence on June 28 were incorrectly given by Prof. Spoerer in the *Memorie* for October (see NATURE, vol. xli. p. 115), and that the following should be substituted :—

Wave-length.	Origin.	Wave-length.	Origin.
667·6 ...	... Fe	553·4 ...	... Ba, Fe, Sr.
C ...	... H.	531·6 ...	... Ceronium.
649·6 ...	... Ba.	526·9 ...	... Ca, Fe.
646·2 ...	... Ca.	518·8 ...	... Ca, Fe.
D_1 ...	... Na.	b_1 ...	... Mg.
D_2 ...	... Na.	b_2 ...	... Mg.
D_3 ...	... Helium.	b_3 ...	... Fe, Ni.
		b_4 ...	... Mg, Fe.

The above table only contains a small number of the bright lines seen in this eruption.

COMET SWIFT (*f* 1889, NOVEMBER 17).—The following corrected elements are given by Dr. Zelbr (*Astr. Nachr.*, 2944) :—

T = 1889 November 29·66411 Berlin Mean Time.

x = 40° 55′ 52″·8
Ω = 331 26 40·1 } Mean Eq. 1889·0.
i = 19 3 21·1
φ = 39 8 23·1
log a = 0·559784
log μ = 2″·710331
Period = 6·91 years.

Dr. Lamp has computed the ephemeris given below from these elements :—

1890.	R.A. h. m. s.	Decl. ° ′	1890.	R.A. h. m. s.	Decl. ° ′
Jan. 8 ...	1 19 48 ...	+25 50·9	Jan. 19 ...	1 59 43 ...	+27 46·2
9 ...	23 25 ...	26 2·8	20 ...	2 3 21 ...	27 55·0
10 ...	27 2 ...	26 14·4	21 ...	6 59 ...	28 3·5
11 ...	30 39 ...	26 25·7	22 ...	10 36 ...	28 11·8
12 ...	34 17 ...	26 36·7	23 ...	14 14 ...	28 19·8
13 ...	37 54 ...	26 47·5	24 ...	17 51 ...	28 27·4
14 ...	41 32 ...	26 58·0	25 ...	21 28 ...	28 34·8
15 ...	45 10 ...	27 8·2	26 ...	25 4 ...	28 41·9
16 ...	48 48 ...	27 18·1	27 ...	28 40 ...	28 48·7
17 ...	52 27 ...	27 27·7	28 ...	2 32 15 ...	28 55·3
18 ...	1 56 5 ...	27 37·1			

The brightness on Jan. 8 = 0·48 and on Jan. 28 = 0·30, that at discovery being taken as unity.

M. Schulhof notes (*Bulletin Astronomique*, November 1889) that, according to the elements of this comet, it is probably identical with Blanpain's comet (1819), which M. Clausen has shown to be identical with Grischow's comet (1743).

SOLAR SPOTS AND PROMINENCES.—In the November *Memorie della Società degli Spettroscopisti Italiani*, Prof. Tacchini contributes a note on spots and faculæ observed from July to September of this year. A comparison of these observations with those of the preceding quarter shows an augmentation of the phenomena described and a diminution of the frequency of days without spots.

Spectroscopic observations made by Prof. Tacchini during the same period as the above show the mean daily number of prominences to have been 2·93, with an average altitude of

38″·8. This is an increase on the results of the preceding quarter both in the number and height of prominences. Two elaborate plates are included in the *Memorie*, indicating the prominences observed at Rome and Palermo from September to December 1886.

GEOGRAPHICAL NOTES.

THE following news was received a few days ago at St. Petersburg from Colonel Roborovski, the present chief of the late M. Prjevalsky's projected expedition. They crossed the Tian-Shan by the Barskaun and Bedel Passes, and reached the Taushkandaria. Then they crossed the Kara-teke chain, and when they were on the banks of the Yarkend river, they found out that the Kashgar-daria no longer reaches the Yarkend-daria, but is lost in the irrigation canals of Maral-bash. They followed the Yarkend river, which rolls a mass of muddy water between quite flat banks, covered for some 15 to 30 miles on both sides of the river, by thickets of *Populus euphratica*, *Populus prunosa*, tamarisks, *Halostachus* shrubs, and rushes. Sand deserts spread on both sides,—towards the west to Kashgar, and eastwards to Lob-nor. Many ruins of old cities are met with in the deserts which are never visited by the natives. In the thickets of shrubs which fringe them there are numbers of tigers and wild boars, while amidst the *barkhans* of the deserts the wild camels are freely grazing. From Yarkend, the expedition went south, towards the hilly tracts, where it stayed for a month, and then it moved towards Kotan, whence Colonel Roborovski wrote on October 7. He proposed to winter at Niya, and to search for a pass to Tibet across the border-ridge to which Prjevalsky gave the name of "Russian Ridge." If they succeed they will spend next summer in Tibet.

IN a lecture lately delivered before the Geographical Society of Bremen, Prof. Kuekenthal, of Jena, gave some account of his researches in King Charles Land. Geologically, these islands belong to Spitzbergen, and not, as was formerly supposed, to Francis Joseph Land. During his stay of nearly three months, Prof. Kuekenthal thoroughly investigated this remote district, which is almost unapproachable, the surrounding seas being densely packed with icebergs. The islands are almost entirely without vegetation; only a few mosses struggle for existence on the clay soil. Numerous walrus skeletons are thrown up by the sea. Game is plentiful; Prof. Kuekenthal shot 14 bears (besides bringing back two live specimens), 39 walruses, and as many seals. Many insects and crustaceans were obtained from the land lakes.

THE ANNIVERSARY OF THE ROYAL SOCIETY.

THE President, after giving an account of the scientific work of many Fellows deceased during the past year, addressed the Society as follows:—

On account of the great importance of Joule's labours, both directly, in the advancement of science, and indirectly, through the knowledge thus acquired, in enabling improvements to be made in the practical application of science for industrial purposes, it has been suggested that it might be desirable to raise some public memorial to him, and the Council has appointed a Committee to consider the question.

I have referred, and that very briefly, to some only of the Fellows whom we have lost during the past year, but fuller details both of them, of other Fellows whom we have lost, and of our recently deceased Foreign Members, will be found in the obituary notices which appear from time to time in the Proceedings, according as they are received from the Fellows who have kindly undertaken to draw them up.

Of those who last year were on our list of Foreign Members, we have since lost one who was truly a veteran in science. More than three years have elapsed since the celebration of the centenary of the birth of M. Chevreul, and two more recurrences of his birthday came round before he was called away. He will be known for his researches on the contrast of colours. But his great work was that by which he cleared up the constitution of the fixed oils and fats, and established the theory of saponification. Few scientific men still surviving were even born when this important research was commenced—a research in the course of which he laid the foundation of the method now universally followed in the study of organic compounds, by showing that an ultimate analysis by itself alone is quite insufficient, and that it is necessary to study the substances obtained by the action of reagents on that primarily presented for investigation.

There is one whose name, though he was not a Fellow, I cannot pass by in silence on the present occasion. I refer to Thomas Jodrell Phillips Jodrell, who died early in September, in his eighty-second year. About the time of the publication of the reports of the Duke of Devonshire's Commission, the subject of the endowment of research was much talked of, and Mr. Jodrell placed the sum of £6000 in the hands of the Society for the purpose of making an experiment to see how far the progress of science might be promoted by enabling persons to engage in research who might not otherwise be in a condition to do so. But before any scheme for the purpose was matured, the Government Grant for the promotion of scientific research was started, under the administration of Lord John Russell, then Prime Minister. This rendered it superfluous to carry out Mr. Jodrell's original intention, but he still left the money in the hands of the Society, directing that, subject to any appropriation of the money that he might make, with the approval of the Royal Society, during his lifetime, the capital should, immediately upon his death, be incorporated with the Donation Fund, and that in the meantime the income thereof should be received by the Royal Society. Of the capital, £1000 was several years ago assigned to a fund for the reduction of the annual payments to be made by future Fellows, and the remaining £5000 has now, of course, been added to the Wollaston Donation Fund. By the Fee Reduction Fund the annual payment of ordinary Fellows elected subsequently to the time of the change was made £3 instead of £4, and the entrance fee abolished. As to the Donation Fund, a very wide discretion was, by the terms of the original foundation, left in the hands of the Council as to the way in which they should employ it in the interest of science.

Since the Croonian Foundation for lectures was put on its present footing, it has been made the means of securing for us the advantage of a lecture delivered before the Society by distinguished foreign men of science. In the present year our Foreign Member, M. Pasteur, was invited to deliver the lecture. Unfortunately, the state of his health would not allow him to deliver it himself, but at one time he hoped that he would have been able to be present at its delivery. It was ultimately arranged that his fellow-labourer at the Pasteur Institute, Dr. Roux, should deliver the Croonian Lecture in his stead; and several of the Fellows have heard his lucid account, first of the discoveries of M. Pasteur in relation to diseases brought about by microscopic organisms, and then further researches of his own in the same field.

In addressing the Fellows at the anniversary last year, I mentioned that Commandant Desforges had kindly offered to compare that portion of Sir George Schuckburgh's scale, with reference to which the length of the seconds pendulum had been determined by Kater and Sabine, with the French standard metre; and as the ratio of this to the English standard yard was accurately known, the length of the pendulum, as determined by these accurate observers, would thus for the first time be brought into relation with the English yard by direct comparison with accurately compared measures of length. The comparison was shortly afterwards executed, and the scale, which, of course, was very carefully packed for its journey to Paris and back, has long since been replaced in the apartments of the Society. This highly desirable comparison occupied but a few days in its execution; which affords one example of the scientific advantages derivable under an international agreement, from the establishment of the Bureau des Poids et Mesures. Our own country, which for some years held aloof from the Convention, forming the sole exception to the general agreement among nations of importance, joined it some years ago; and we thus have the privilege of availing ourselves, as occasion may arise, of the appliances at the office in Paris for such comparisons of measures of length or weight.

The services of Mr. Arthur Soper, as a special assistant, have been retained during the past session, with advantage to the library. He has completed the much-needed shelf catalogue, and the re-arrangement of the books where necessary. In the course of this work the volumes of a purely literary character

have been collected together, and a selection of the most valuable have been preserved in a properly protected case. Of the remainder, about 150 volumes (in addition to those reported last year) have been presented to various public libraries, and a slip catalogue of the volumes which are retained, containing about 1700 entries, has been prepared.

The manuscripts (other than the originals of ordinary papers read at the meetings) which have accrued to the Society since the publication of Halliwell's Catalogue have been collected from various parts of the building into the Archives Room, with the object of preparing a complete catalogue of the manuscripts at present in the possession of the Society.

Since the last anniversary, twenty-four memoirs have been published in the Philosophical Transactions, containing a total of 753 pages and 33 plates. Of the Proceedings, twelve numbers have been issued, containing 1062 pages and 6 plates. Dr. R. von Lendenfeld's "Monograph of the Horny Sponges," mentioned in my last anniversary address, has also been issued during the year in a quarto volume of 940 pages of text and 51 plates.

The Fellows are aware that for a great many years the Royal Society has devoted a part of its funds to the collection, preparation for the press, and correction of the proofs of a Catalogue of Scientific Papers. We have endeavoured to make the work as complete as possible, and to include scientific serials in all languages. The first part, covering the period 1800-63, is printed in six thick quarto volumes, of which the last appeared in 1872. The decade 1864–73 occupies two more volumes, of which the second was published in 1879. This work, in the preparation of which the Royal Society has spent a large sum, is for the benefit of the whole civilized world, and the sale of it could not be expected nearly to cover the cost of printing, paper, and binding. On a representation to this effect being made to Government, when the first part was ready for the press, the Lords of the Treasury consented that it should be printed at the public expense, the proceeds of the sale of the work, after reserving a certain number of copies for presentation, being repaid to the Treasury. In consideration of the large outlay involved in the preparation, those Fellows of the Society who wished to purchase the work could do so at about two-thirds of the cost to the general public. A similar application to the Treasury with reference to the decade 1864-73 met with a similar response, and we proceeded, as I mentioned at the anniversary last year, with the preparation of the manuscript for the next decade, 1874-83, which was then nearly ready. On making application towards the end of last year to the Treasury for the printing of this decade, our request was not acceded to. While declining, however, to continue any further the printing of this great work, the sum of £1000 was put in the Estimates, and has since been voted by Parliament, to assist us in the publication, and the copies of the work still remaining unsold have been handed over to us. This has enabled us to conclude negotiations with Messrs. Clay and the Syndics of the Cambridge University Press for the printing of the decade last mentioned, and at the same time to make some provision towards the future continuation of the work, without, as it may be hoped, encroaching to a greater extent than hitherto on our own resources.

The utility of the work would obviously be much increased if it could be furnished with some sort of key enabling persons to find what had been written on particular subjects. I am not without hopes that this very desirable object may yet be accomplished, notwithstanding the magnitude of any such undertaking.

Within the last year the Council of the Royal Society has accepted a duty in connection with scientific agriculture, of which it will be interesting to the Fellows to be informed. It is well known that for the last fifty years, or thereabouts, Sir John Lawes has carried out on his estate at Rothamsted an elaborate and most persevering series of experiments on the conditions which influence the growth and yield of crops of various kinds, the effect of manures of different kinds, the result of taking the same crop, year after year, from off the same land without supplying to it any manure, &c. Long as these experiments have already been continued, there are questions, particularly as regards the capabilities of the sub-soil, which require for their satisfactory answers that similar experiments should be continued on the same land for a still longer period. In respect of such questions, the investigator of the science of agriculture is in a position resembling that in which the astronomer is often placed, in having to make observations, the full interest of which it must be left to posterity to enjoy.

To prevent the interruption of these experiments, which it would take a life-time to repeat on fresh ground, and at the same time to provide for the carrying out of researches generally bearing on the science of agriculture, Sir John Lawes has created a trust, securing to the trustees a capital sum of £100,000, and leasing to them for ninety-nine years, at a peppercorn rent, certain lands in his demesne on which the experiments have hitherto been carried on, together with his laboratory. The trust is intended to be for original research, not for the instruction of students. The general direction of the experiments and researches to be carried on is vested in a committee of management consisting of nine persons, of whom four are to be appointed by the President and Council of the Royal Society.

The trustees named in the deed were Sir John Lubbock, Dr. Wells, and our Treasurer, Dr. Evans. One of these is now no more. Lord Walsingham has been appointed a trustee in place of the late Dr. Wells.

The Copley Medal for the year has been awarded to Dr. Salmon for his various papers on subjects of pure mathematics, and for the valuable mathematical treatises of which he is the author. Dr. Salmon's published papers are all valuable. Among others may be mentioned his researches on the classification of curves of double curvature, and on the condition for equal roots of an equation; the very important theorem of the constant anharmonic ratio of the four tangents of a cubic curve; his researches on the theory of reciprocal surfaces; his paper on quaternary cubics. But any notice of his contributions to the advancement of pure mathematics would be incomplete which did not specially mention his invaluable text-books on conic sections, higher plane curves, solid geometry, and the modern algebra—works which not only give a comprehensive view of the subjects to which they relate, but contain a great deal of original matter.

Of the Royal Medals, it is the usual though not invariable practice to award one for mathematics or physics, including chemistry, and one for some one or more of the biological sciences. No distinction is, however, made between the two medals in point of order of precedence, and I will, therefore, take the names of the medallists in alphabetical order.

The Council have awarded one of the Royal Medals this year to Dr. Walter Holbrook Gaskell for his researches in cardiac physiology, and his important discoveries in the anatomy and physiology of the sympathetic nervous system.

In his memoir, "On the Rhythm of the Heart of the Frog" (Croonian Lecture, Phil. Trans., 1882), and in a subsequent memoir, "On the Innervation of the Heart of the Tortoise" (*Journ. of Physiol.*, vol. iv.), Dr. Gaskell very largely advanced our knowledge of the physiology of the heart-beat, more especially as relates to the sequence of the beats of the several parts, the nature of the inhibitory action of the vagus nerve, and the relations of tonicity and conducting power to rhythmical contraction. These memoirs, however, lacked completeness on account of their not taking into full consideration the action of the cardiac augmentor or accelerator fibres, the existence of which had been previously indicated in the case of mammals, and suspected in the case of the frog and allied animals.

By a striking experiment (*Journ. of Physiol.*, vol. v.) Dr. Gaskell subsequently gave the first clear demonstration of the presence in the frog of cardiac augmentor fibres; also he gave a clear account of the nature of the action of their fibres, and the relations of that action to the action of the vagus fibres. Revising his previous work by the help of the light thus gained, Dr. Gaskell was enabled to give the first really consistent and satisfactory account of the nature of the heart-beat, of the modifications of beat due to extrinsic nerves, and of the parts played by muscular and nervous elements respectively.

Important as was this work on the heart, Dr. Gaskell's subsequent work "On the Structure, Functions, and Distribution of the Nerves which govern the Vascular and Visceral Systems" (*Journ. of Physiol.*," vol. vii.) has a far higher importance and significance. In spite of the knowledge which during the past thirty or forty years has been gained concerning vaso-motor nerves and the nerves governing the movements of the viscera, physiologists had up to the time of the appearance of Dr. Gaskell's memoir failed to obtain a clear conception of the nature and relations of the so-called sympathetic nervous system. By his researches, in which the several methods of

gross anatomical investigation, minute histological examination, and experimental inquiry were, in a striking manner, made to assist each other, Dr. Gaskell, by tracing out the course and determining the nature of vaso-constrictor and vaso-dilator fibres, and comparing them with the cardiac augmentor and inhibitory fibres, and with the fibres governing the visceral muscles, has already reduced to order what previously was to a large extent confusion, and has opened up what promises to be the way to a complete understanding of the whole subject.

The results arrived at, besides their great physiological importance, on the one hand promise to be of great assistance in practical medicine, and on the other are eminently suggestive from a purely morphological point of view.

The other Royal Medal has been awarded to Prof. Thomas Edward Thorpe for his researches on fluorine compounds, and his determination of the atomic weights of titanium and gold.

Prof. Thomas Edward Thorpe's experimental work has secured for him a place in the first rank of living experimentalists.

His researches, which are not confined to one department of chemical science, but extend over many branches, are all distinguished both by accuracy and originality of treatment. As examples of the high character of his investigations, those of the determinations of the atomic weights of titanium and gold may be specially cited as permanently settling the value of two most important chemical constants; whilst his researches on the fluorine compounds, including the discovery of thiophosphoryl fluoride, a body capable of existing undecomposed in the state of gas, and his latest work on the vapour-density of hydrofluoric acid, do not fall short of the highest examples of classical chemical investigation.

The Davy Medal has been awarded to Dr. W. H. Perkin for his researches on magnetic rotation in relation to chemical constitution.

Dr. Perkin is well known as the originator of what is now a great industry, that of the coal-tar colours, by his preparation and application to tinctorial purposes of a colouring matter which had previously merely been noticed as affording a chemical test for the presence of aniline. This, however, is now a long time ago, and it is for more recent work, the interest of which is purely scientific, that the medal has been awarded to him.

Dr. Perkin first showed, in 1884, that a definite relationship exists between the chemical constitution of substances and their power of rotating the plane of polarization of light when under magnetic influence; and he pointed out how the "molecular coefficient of magnetic rotation" or "molecular rotatory power" might be deduced.

In 1884 he presented to the Chemical Society a lengthy paper describing his method, and the results obtained for a very large number of paraffinoid hydrocarbons and haloid and oxygenated derivatives thereof; from these he deduced "constants," which he has since shown to be applicable in calculating the magnetic rotatory power of paraffinoid compounds generally. From time to time he has published further instalments of his work, and only quite recently has described the results obtained on examining nitrogen compounds, which exhibit many most interesting peculiarities.

The results are of special value on account of the exceptional care devoted to the preparation of pure substances, and the guarantee, which Dr. Perkin's reputation affords, that everything possible has been done to secure accuracy; and also because the substances chosen are for the most part typical substances, or belong to series in which a simple relationship exists.

HAIL-STORMS IN NORTHERN INDIA.

IN a paper recently published in the Journal of the Asiatic Society of Bengal, Mr. S. A. Hill describes certain severe hail-storms and tornadoes that occurred on April 30 and May 1, 1888, in the Gangetic *doab* and Rohilkand in Northern India.[1] Tornadoes are not very common in India, but they appear to have been somewhat more prevalent than usual in the spring of 1888, the storms in question having been preceded on April 7 by a very destructive tornado at Dacca in Bengal, a full description of which was given by Mr. Pedler and Dr. Crombie in a previous number of the Society's Journal. Like all previously recorded storms of this character, these occurred in the spring, when the seat of minimum pressure is established in the Lower Punjab, and a trough of low pressure extends from this region eastward to the Gangetic plain. To the south of this trough very dry west winds, the hot winds of Northern India, prevailed in Rajputana and Central India, while, to the north of it, damp easterly winds blew up the northern margin of the plain and across the outer slopes of the Himalaya. It is apparently in the meeting of these two winds, where the former blows in an upper, the latter in the lower, stratum, that are generated the thunder squalls that form a normal feature of the spring months in Northern India; and tornadoes, as Prof. Ferrel has shown, are merely an exaggerated development of the thunder squall. In the present instance, ordinary storms of this character, and dust storms, occurred pretty generally over all the north-western districts of the North-West Provinces, simultaneously with the tornadoes in Rohilkand and the Gangetic *doab*.

From the evidence quoted by Mr. Hill, it does not appear indeed to be positively established that any of the storms described exhibited all the characteristic features of tornadoes, as was undoubtedly the case of the Dacca storm. No mention is made in any of the reports of any whirling column having been actually observed; and that whirlwinds were the real agents of destruction seems to be inferred chiefly from the destructive force of the wind, especially its lifting power, and some rather vague reports on the wind's changes during the passage of the storm. On a point of this kind, however, in India, negative evidence goes for little, and the chief subject discussed in Mr. Hill's paper, viz. the conditions which determine these atmospheric disturbances, is of equal interest, whether they were really tornadoes or only remarkably severe hail-storms of the more usual kind.

In the barometric changes of the days preceding the storms there does not appear to be anything that throws much light on their genesis. The relative distribution of pressure shown by the observations on the Indo-Gangetic plain underwent but little variation, and the existence of a slight secondary depression in the immediate neighbourhood of the storm tract, on April 30, is inferred solely on the evidence of two Himalayan stations at elevations of 5300 feet and 6000 feet above the sea, and may be delusive. There had, however, been a general steady fall of the barometer for three days before the storms of April 30—one of those oscillations, apparently, which Mr. Abercromby has termed surges, and a rapid rise set in after the storms. As has been pointed out elsewhere, this is an ordinary recurrent feature of the season.

It is in the changes in the vertical distribution of temperature that Mr. Hill finds the conditions that determined the atmospheric disturbance. Taking as his fundamental data the observed temperatures of the three stations, Roorkee at 886 feet, Dehra at 2233 feet, and Mussooree at 6881 feet, and assuming that these represent approximately the rate of vertical decrease over the neighbouring plain, he computes the fall of temperature for increments of 1000 feet up to 10,000 feet by means of a simple formula of interpolation, and finds that, up to the forenoon of April 30, the condition of unstable equilibrium which results from the diurnal heating of the plains did not extend beyond 3000 or 4000 feet above the ground surface. This would set up a considerable amount of convective interchange between these lower strata, but the cloud-forming strata would still be in a stable condition, at least in a non-saturated atmosphere. On the afternoon of April 30, the conditions were changed. With a great fall of temperature at the lowest and highest stations, as compared with the previous day at the same hour, that of the intermediate station was but little affected, and hence the computed table shows a reduction of the vertical decrement at low levels, a corresponding increase at the higher levels, and a transfer of the condition of unstable equilibrium from the former to the latter. Simultaneously with this change took place that violent disturbance of the atmosphere that resulted in the hail-storms on the plains.

Mr. Hill's conclusions are entirely in accord with what might be expected on *a priori* grounds. But before they can be fully accepted, it is necessary to scrutinize the data, and as the result of this scrutiny we must confess they do not seem to us completely convincing. We may put aside the question whether and to what extent the empirical formula of interpolation adopted by Mr. Hill really expresses the law of decrement of temperature, since, although it would evidently fail for extrapolation much beyond the altitude of 7000 feet, it probably does not involve any very serious error below that limit, provided the numerical values afforded by observation are trustworthy. The

[1] *Op. cit.*, vol. lviii., Part 2, No. 2, 1889.

critical point of the whole reasoning is whether the observed temperatures at the three stations Roorkee, Dehra, and Mussooree, can be safely accepted as approximately representing those of the free atmosphere over the plains at the same levels, and this seems to us at least open to question. In the case of the lowest and highest stations, indeed, there is not much to object to. Roorkee is a fairly representative station of the northern part of the Gangetic plain, and the Mussooree Observatory, situated on the very crest of the ridge of the Himalaya, overlooking the plains, is probably as little affected by the local heating of the ground as any mountain observatory can be. But Dehra, which furnishes the really critical datum of Mr. Hill's reasoning, is on the plain of the *Dún*, a flat valley six or eight miles across, stretching between the Sivaliks and the foot of the Mussooree ridge, and it is by no means self-evident that the local temperature is not largely affected by causes which are quite inoperative in the free atmosphere at the same elevation over the plains.

In our opinion, then, Mr. Hill's conclusion that the storms of April 30 and May 1 were determined by a change in the vertical distribution of temperature, transferring the condition of instability from the lower to the higher atmospheric strata, is at least open to doubt. To a certain extent, indeed, it is supported by the evidence of other observatories in the North-West Himalaya, especially Chakrata, the situation of which is very similar to that of Mussooree; but the difference of their elevation (170 feet) is too small to allow of its having much weight in determining the point at issue.

The most noteworthy feature of the storm of April 30 was the fearful loss of life caused by it at Moradabad. Not less than 230 deaths were reported at this station alone, the vast majority of which were caused directly by the hail. The collector's report states that men caught in the open and without shelter were simply pounded to death. The spring is especially the season of native weddings, and "more than one marriage party was caught by the storm near the banks of the river and was annihilated." It is, however, suggested by Mr. Hill that many of the deaths may have been caused by cold. "Immediately before the storm the temperature had been very high, and many if not the majority of the deaths due to it may have been occasioned by the persons exposed to its fury being knocked down and temporarily packed in ice." At Moradabad the hailstones are stated to have been the size of plums—probably the *bér* plum, *Zizyphus jujuba*, the cultivated form of which is two or three times as large as a walnut.

In the storm of May 1, the hailstones at some places were larger, though the destruction was less. At Ghaziabad they are said to have been as large as cricket balls, and one was picked up at Delhi weighing 4½ ounces. At Tilhar they are reported to have been larger than goose eggs, and at a neighbouring place they averaged 3 inches in diameter. Their form is described as a flat oval.

SCIENTIFIC SERIALS.

Bulletin de l'Académie Royale de Belgique, November 1889.—On the existence of a gizzard, and on its structure, in the family of the Scolopendridæ, by M. Victor Willem. The presence of a gizzard in the lower organisms was first determined by M. F. Plateau in 1876. But the gizzard of insects was long supposed to be merely a triturating organ acting mechanically, without any physiological function. Continuing Plateau's researches, M. Willem now finds that the gizzard is not only present in several genera of the Scolopendrid family, but that it is a true digester. The structure is fully described, and illustrated by two plates, on which are figured the gizzards of *Scolopendra hispanica*, *S. cingulata*, *S. heros*, *Scolopocryptops*, *Cryptops punctatus*, and *C. hortensis*. In these last, the apparatus is most highly developed, being even more complicated than amongst the higher order of insects. No explanation is offered of this apparent anomaly.—Unexpected proof of diurnal nutation, and necessity of taking it into consideration in the reduction of observations, by M. F. Folie. The coefficient of diurnal nutation as already approximately determined at 0·01s. by the author's numerous researches, has recently been confirmed in a somewhat remarkable manner by the results of M. Kobold's observations of the Polar star with the meridian circle of Strassburg. The azimuthal errors of this instrument were found to present, not an annual, but a diurnal period, and Kobold's corrections are shown to be illusory, being due to his neglect of the element of diurnal nutation in the reduction of his observations. When this element is taken into account, the results harmonize with those previously arrived at by M. Folie.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, Dec. 19, 1889.—"On the Effects of Pressure on the Magnetization of Cobalt." By C. Chree, M.A., Fellow of King's College, Cambridge. Communicated by Prof. J. J. Thomson, F.R.S.

It has long been known, from the classic researches of Dr. Joule, that a rod of iron free from stress increases in length when magnetized in a comparatively weak field. When, however, the strength of the field is continually raised, it has been found by Mr. Shelford Bidwell that the rod ceases to increase in length, and then shortens, so that in a sufficiently strong field the length becomes less than it was originally. It has also been found by Villari, Sir W. Thomson, and others, that when a rod of iron is exposed to successive loadings and unloadings of a given weight in a magnetic field, there appears a corresponding cyclic change of magnetization. In this cyclic change the maximum magnetization occurs when the load is "on," or when the load is "off," according as the field is weaker or stronger than a certain critical field depending on the load, called by Sir W. Thomson the Villari critical field.

Cobalt has been found by Mr. Shelford Bidwell to shorten when magnetized in weak fields, but to lengthen in very strong fields. The field in which it ceases to shorten is very much higher than the field in which iron ceases to lengthen. Also in weak fields Sir W. Thomson has found the magnetization of a cobalt rod under cyclic applications of tension to be least when the tension is "on."

Now, Prof. J. J. Thomson has shown that on dynamical principles the effect of changes of magnetization on the length of a rod of magnetic metal, and the effect of changes in the length of the rod on the magnetization, must be fundamentally connected. In his "Applications of Dynamics to Physics and Chemistry," he has arrived at mathematical equations connecting the two phenomena, such that from a knowledge of the one set of phenomena the character of the other set can be deduced.

The conclusions derived from the theory are in the case of iron in accordance with the results of experiment, at least in their general character. In cobalt there is also an agreement between theory and experiment, so far as Sir W. Thomson's experiments go. In the absence of further experiments it would, however, be impossible to tell whether or not this agreement extended to the strong fields in which occurred the important phenomena observed by Mr. Shelford Bidwell. The application of Prof. J. J. Thomson's formulæ to Mr. Shelford Bidwell's results led him to the conclusion that under cyclic applications of pressure a cobalt rod should experience cyclic change of magnetization, and that the maximum magnetization should answer to pressure "on," or to pressure "off," according as the magnetic field was weaker or stronger than a critical field, corresponding to the Villari field in iron. It was for the purpose of determining whether such a critical field did actually exist that the present investigation was commenced at Prof. J. J. Thomson's suggestion.

Employing the magnetometric method, it was found that the agreement between theory and experiment was at least as satisfactory in cobalt as in iron. The application of pressure-cycles in a magnetic field led to a cyclic change of magnetization in a cobalt rod, in which the maximum magnetization occurred when pressure was "on," or when it was "off," according as the strength of the field was below or above 120 C.G.S. units. This accordingly was the Villari critical field foreshadowed by theory.

In weak fields the first pressure applied after the introduction of the cobalt rod into the magnetizing coil caused a large increase in the induced magnetization. As the strength of the field was raised, this change in the magnetization attained a maximum, then, diminishing, vanished in a field considerably stronger than the Villari field for the cyclic effect, and in all stronger fields consisted in a diminution of magnetization.

Both Villari and Prof. Ewing observed that, after the break of the magnetizing current, cyclic changes of tension produced

eventually, in iron wires, cyclic changes of the residual magnetization. In these, the maximum magnetization answered, as in the induced magnetization in fields below the Villari point, to tension "on."

In the present investigation, the existence of a cyclic change in the residual magnetization of cobalt accompanying cyclic changes of pressure has been established, and the magnitude of the effect examined in a large number of fields, extending from 0 to 400 C.G.S. units. It was found that not only the magnitude, but the sign even, of the effect depended largely on the condition of the rod during the break of the current. When the rod was under pressure during the break, the residual magnetization in the cyclic state showed a maximum under pressure, whatever was the strength of the pre-existing field. When, however, the rod was free from pressure during the break of the current, it was only in the residual magnetization left after the weakest fields that the maximum answered to pressure "on." When the strength of the pre-existing field was raised, the effect passed through the value zero and changed sign.

"On the Extension and Flexure of Cylindrical and Spherical Thin Elastic Shells." By A. B. Basset, M.A., F.R.S.

The method which I have employed in dealing with problems relating to the equilibrium and motion of thin cylindrical and spherical elastic shells, is as follows :—

Taking the case of a cylindrical shell, let OADB be a small curvilinear rectangle described on the middle surface, of which the sides OA, BD are generators, and the sides AD, OB are circular sections. The resultant stresses per unit of length across the section AD are completely specified by the following five quantities, viz. (1) a tension, T_1; (2) a tangential shearing stress, M_2; (3) a normal shearing stress, N_2; (4) a flexural couple, G_2; (5) a torsional couple, H_1; and the stresses across BD may be derived by interchanging the suffixes 1 and 2. If, therefore, we resolve all the forces which act upon the element along OA, OB and the normal, and take moments about these lines, we shall obtain the six equations of motion in terms of these stresses.

The expression for the potential energy is next found, which differs from that obtained by Mr. Love (Phil. Trans., 1888), owing to the fact that he has omitted to take into account several terms involving the product of the extensions and the cube of the thickness.

The variational equation can now be written down, and if it be applied to a curvilinear rectangle bounded by two lines of curvature and worked out in the usual way, the line integral part will determine the values of the edge stresses $T_1, T_2, \ldots$ in terms of the displacements; and the surface integral part will determine the three equations of motion in terms of the displacements. These results furnish a test of the accuracy of the work, and also of the fundamental hypothesis upon which the theory is based (viz. *that if the surfaces of the shell are not subjected to any surface pressures or tangential stresses, the three stresses, R, S, T, are of the order of the square of the thickness*); for if we substitute the values of the edge stresses in the last three of our original equations, they ought to reduce to identities; whilst if we substitute these values in the first three, we ought to reproduce the equations of motion which we have obtained by means of the variational equation; and this is found to be the case.

The boundary conditions are obtained by Stokes's theorem, which enables us to prove that it is possible to apply a certain distribution of stress to the edge of a thin shell, without producing any alteration in the potential energy due to strain.

Geological Society, December 18, 1889.—W. T. Blanford, F.R.S., President, in the chair.—The following communications were read :—On the occurrence of the genus *Girvanella*, and remarks on Oolitic structure, by E. Wethered. The author referred to his previous work, wherein he had shown that *Girvanella* is not confined to Silurian rocks, and that as a rock-forming organism it is more important than was supposed, occurring in the Gloucestershire Pea-grit, and also in the Coralline Oolite of Weymouth. He now dealt more in detail with its occurrence (1) in the *Carboniferous Oolitic Limestone*; and (2) in the *Jurassic Oolites*. In the Carboniferous limestone of the Avon valley, Oolitic limestone occurs on four horizons, in three of which the Oolites rest on dolomite. In none of these three cases are there signs of *Girvanella*. From beds partly Oolitic, and not resting on dolomite, he has been able to determine two new species. The Oolite not associated with dolomite is less crystalline, and the original structure is better preserved. In referring to *G. pisolitica*, he discussed whether *Girvanella* is most allied to the *Challenger* Foraminifer, *Hyperammina vagans*, or to *Syringammina fragilissima*. Traces of the organism occur in the *Clypeus*-grit, but none are quoted from beds of the Great Oolite, nor from the Portland Oolite. The author had already shown that the pisolites in the Coralline Oolite of Weymouth were not concretions, but forms of *Girvanella*. Excluding these, he showed that the spherules are of four types, of which one is the ordinary Oolitic granule, while each of the others suggests the presence of *Girvanella*. The characters of the genus, as seen under the microscope were indicated, and four new species were described. The President remarked on the importance of investigating the question whether these appearances are organic or not. We should take warning from *Eozoon* as to possible differences of opinion in the interpretation of tubular structure, though these mystifying appearances seem more common in serpentine and chalcedony than in calcite. In the bodies depicted, the wall, the irregularity, and the manner in which the tubes curve round each other are in favour of their being organic. Prof. Rupert Jones thought that these forms were not due to mineral but to organic laws. Dr. Evans, while disclaiming any special knowledge of the subject, suggested that the appearances might be interpreted on the supposition of an organism boring into a comparatively hard substance. Dr. Hinde, who had seen most of the known species of *Girvanella*, spoke of the wide distribution of these organisms. Remarks were also offered by Dr. Hicks, Prof. Bonney, Prof. Judd, the Rev. H. H. Winwood, and the author.—On the relation of the Westleton Beds or "Pebbly Sands" of Suffolk to those of Norfolk, and on their extension inland, with some observations on the period of the final elevation and denudation of the Weald and of the Thames Valley, Part 2, by Prof. Joseph Prestwich, F.R.S.—The author having, in the first part of this paper (Proc. Geol. Soc., June 5, 1889), discussed the relationship of the Westleton Beds to the Crag series and to the Glacial deposits, proceeded in the present contribution to consider the extension of the Westleton Beds beyond the area of the Crag, and described their range inland through Suffolk, East, West, and South Essex, Middlesex, North and South Hertfordshire, South Buckinghamshire, and North and South Berkshire, noticing their relationship to the overlying Glacial beds, where these were developed, and the manner in which they reposed upon older deposits. He gave an account of the heights of the various exposures above Ordnance Datum, and mentioned the relative proportion of the different constituents in various sections, thus showing that in their southerly and westerly extension they differed both in composition and in mode of distribution from the Glacial deposits. Distinction was also made between the Westleton Beds and the Brentwood Beds. Attention was next directed to the occurrence of the Westleton series, south of the Thames, in Kent, Surrey, and Hampshire, and their possible extension into Somersetshire was inferred from the character of the deposits on Kingsdown and near Clevedon. In tracing the deposits from the east coast to the Berkshire Downs, the author noticed that at the former place the beds lay at sea-level, but ranging inland, they gradually rose to heights of from 500 to 600 feet; that in the first instance they underlay all the Glacial deposits, and in the second they rose high above them, and their seeming subordination to the Glacial series altogether disappeared; thus at Braintree, where the Westleton Beds were largely developed, they stood up through the Boulder-clay and gravel which wrapped round their base, whilst further west, where they became diminished to mere shingle-beds, they attained heights of from 350 to 400 feet, capping London-clay hills, where the Boulder-clay lay from 80 to 100 feet lower down the slopes, the difference of level between the two deposits becoming still greater in a westerly direction, until finally the Boulder-clay disappeared. The origin of the component pebbles of the beds was discussed, and their derivation traced (1) to the beds of Woolwich age in Kent, North France and Belgium, and possibly to some Diestian beds, (2) to the older rocks of the Ardennes, (3) to the Chalk and older drifts, and (4) to the Lower Greensand of Kent and Surrey, or in part to the Southern drift. The marine nature of the beds was inferred from the included fossils of the type-area, and the absence of these elsewhere accounted for by decalcification. The southward extension of the beds was shown to be limited by the anticlinal of the Ardennes and the Weald, and the scanty palæontological evidence of the nature of that land was noted, and the possible existence of the Scandinavian ice-sheet to the north was referred to in connection with the disappearance of the

beds in that direction. From the uniform character of the Westleton shingles, the author maintained that they must originally have been formed on a comparatively level sea-floor, and that the inequalities in distribution had been produced by subsequent differential movement to the extent of 500 feet or more to the north and west above that experienced to the east and south, where the chronological succession remained unbroken, also that the inequalities below the level of the Westleton beds had been produced since the period of their deposition, as, for instance, the gorge of the Thames at Pangbourne and Goring, and most of the Preglacial valleys in the district; furthermore, evidence was adduced in favour of the formation of the escarpments of the Chalk and Oolites since Westleton times, whilst certain observations supplied data for estimation of the relative amounts of pre- and post-glacial denudation of the valleys. It was stated, in conclusion, that the time for the vast amount of denudation was so limited that it was not easy to realize that such limits could suffice, but the author did not see how the conclusions which he had arrived at could well be avoided. After the reading of this paper there was a discussion, in which the President, Mr. Topley, Prof. Hughes, and others took part.

Linnean Society, December 19, 1889.—Mr. J. G. Baker, F.R.S., Vice-President, in the chair.—Prof. P. M. Duncan made some supplementary remarks on a specimen of *Hyalonema Sieboldii*, which he had exhibited at a previous meeting.—Mr. W. Hatchett Jackson exhibited and gave an account of an electric centipede (*Geophilus electricus*), detailing the circumstances under which he had found it at Oxford, and the results of experiments which he had made with a view of determining the nature and properties of a luminous fluid secreted by it. This, he found, could be separated from the insect, and could be communicated by it to every portion of its integument. An interesting discussion followed, in which Mr. Briese, Mr. A. W. Bennett, Prof. Stewart, Mr. A. D. Michael, Dr. Collingwood, Mr. Christy, and Mr. J. E. Harting took part. The last-named speaker pointed out that the observations made by Mr. W. Hatchett Jackson on this centipede had been long ago anticipated by Dr. Macartney in an elaborate paper on luminous insects published in the Philosophical Transactions for 1810 (vol. c. p. 277).—A paper was then read by Mr. T. Johnson on *Dictyopteris*, in which he gave a detailed account of the life-history of this brown seaweed, with remarks on the systematic position of the *Dictyotaceæ*. Dr. Scott, Mr. George Murray, and Mr. A. W. Bennett criticized various portions of the paper, and acknowledged the important scientific bearing of the facts which had been brought out by Mr. Johnson's careful and minute researches.—In the absence of the author, Mr. W. P. Sladen detailed the more important portions of a paper by the Rev. John Gulick, on intensive segregation and divergent evolution in land Mollusca; a paper which might be regarded as a continuation and amplification of the views which the same author had expressed in a former paper published in the Society's Journal last year (vol xx., Zool., pp. 189-274).

PARIS.

Academy of Sciences, December 30, 1889.—M. Hermite in the chair.—List of the prizes awarded to successful competitors in the various branches of science during the year 1890:—*Geometry*: Prix Francœur, M. Maximilien Marie; Prix Poncelet, M. Édouard Goursat. *Mechanics*: Extraordinary Prize of 6000 francs, MM. Caspari, Clauzel, and Degouy, 2000 francs each; Prix Montyon, M. Gustave Eiffel; Prix Plumey, M. Widmann. *Astronomy*: Prix Lalande, M. Gonnessiat; Prix Valz, M. Charlois; Prix Janssen, Mr. Norman Lockyer. *Physics*: Prix L. La Caze, M. Hertz. *Statistics*: Prix Montyon, two prizes awarded—one to the late M. Petitdidier and M. Lallemand, the other to Dr. F. Ledé. *Chemistry*: Prix Jecker, MM. A. Combes, R. Engel, and A. Verneuil; Prix L. La Caze, M. F. M. Raoult. *Geology*: Prix Delesse, M. Michel Lévy. *Botany*: Prix Desmazières, M. E. Bréal; Prix Montagne, MM. Ch. Richon and Ern. Roze; Prix Thore, MM. de Bosredon and de Ferry de la Bellone. *Agriculture*: Prix Vaillant, M. Ed. Prillieux. *Anatomy and Zoology*: Grand Prize of the Medical Sciences, MM. L. Félix Henneguy and Louis Roule. *Medicine and Surgery*: Prix Montyon, three prizes were awarded to M. A. Charrin, to MM. A. Kelsch and P. L. Kiener, and to M. Basile Danilewsky, respectively; Prix Bréant, M. A. Laveran; Prix Barbier, MM. M. E. Duval, Ed. Heckel, and F. Schlagdenhauffen; Prix Godard, M. A. Le Dentu; Prix Lallemand, M. Paul Loye; Prix Bellion, MM. F. Lagrange, and Laborde and Magnan; Prix Mège, Dr. A. Auvard. *Physiology*: Prix Montyon, M. A. d'Arsonval; Prix L. La Caze, M. François Franck; Prix Pourat, Dr. Johannes Gad and Dr. J. F. Heymans; Prix Martin-Damourette, M. J. V. Laborde. *Physical Geography*: Prix Gay, M. Drake del Castillo. *General Prizes*: Prix Montyon (Unhealthy Industries), honourable mention of Dr. Maxime Randon; Prix Trémont, M. Jules Morin; Prix Gegner (Physiology), M. H. Toussaint; Prix Petit d'Ormoy (Natural Sciences), M. Jean Henri Fabre; Prix Petit d'Ormoy (Mathematical Sciences), M. Paul Appell; Prix Leconte (Chemical Explosives), M. Paul Vieille; Prix Laplace, two prizes, *ex æquo*, to MM. E. A. A. Verlant and E. Ch. E. Herscher.—The following prizes were proposed for the year 1890:—Grand Prize of the Mathematical Sciences: To perfect in any important point the theory of differential equations of the first order and of the first degree. Prix Bordin: To study the surfaces whose linear element may be reduced to the form

$$ds^2 = [f(u) - \phi(v)](du^2 + dv^2).$$

Prix Francœur: Inventions or works tending to the progress of pure and applied mathematics. Prix Poncelet: The author of any work tending most to further the progress of pure and applied mathematics. Extraordinary Prize of 6000 francs: Any improvements tending to increase the efficiency of the French naval forces. Prix Montyon: Mechanics. Prix Plumey: Improvement of steam-engines or any other invention contributing most to the progress of steam navigation. Prix Lalande: Astronomy. Prix Damoiseau: To perfect the theory of the long periodical irregularities in the movement of the moon caused by the planets. Prix Valz: Astronomy. Prix Janssen: Physical Astronomy. Prix Montyon: Statistics. Prix Jecker: Organic chemistry. Prix Fontannes: The author of the best work on palæontology. Prix Vaillant: Researches on the agencies that have caused the foldings in the terrestrial crust—part played by horizontal displacements. Prix Gay: Orographic study of any mountain system by new and rapid processes. Prix Barbier: Any valuable discovery in the surgical, medical, or pharmaceutical sciences, and in therapeutic botany. Prix Desmazières: The best work on the whole or any part of the Cryptogamic flora. Prix Montagne: The authors of important works on the anatomy, physiology, development, or description of the lower Crytogamic plants. Prix Thore: Works on the cellular Cryptogams of Europe, and on the habits or anatomy of any species of European insect, alternately. Prix Bordin: Comparative study of the auditory nerve in mammals and birds. Prix Savigny: For young zoological travellers. Prix Serres: On general embryology applied as far as possible to physiology and medicine. Prix Dusgate: The best work on the diagnosis of death, and on the means of preventing premature burials. Prix Montyon: Medicine and surgery. Prix Bréant: The discovery of a certain cure for Asiatic cholera. Prix Godard: On the anatomy, physiology, and pathology of genito-urinary organs. Prix Lallemand: Researches on the nervous system in the widest sense of the term. Prix Bellion: Works or discoveries serviceable to the health of man or to the improvement of the human species. Prix Mège: The author of a continuation and completion of Dr. Mège's essay on the causes that have retarded or favoured the advancement of medicine. Prix Montyon: Experimental physiology. Prix Pourat: On the properties and functions of the nervous cells attached to the organs of sense or to any one of them. Prix Delalande-Guérineau: For the French traveller or naturalist who shall have rendered the greatest service to France or to science. Prix Jérome Ponti: The author of any scientific work the continuation or development of which may be deemed valuable to science. Prix Montyon: Unhealthy industries. Prix Trémont: For any naturalist, artist, or mechanic needing help in carrying out any project useful or glorious for France. Prix Gegner: In aid of any *savant* distinguished by solid work done towards the advancement of the positive sciences. Prix Laplace: For the best student leaving the École Polytechnique.

BERLIN.

Physical Society, December 20, 1889.—Prof. von Helmholtz, President, in the chair.—Dr. Assmann demonstrated his aspiration thermometers and psychrometers after having first explained the theory and construction of the latter (see NATURE, vol. xxxvii. p. 215, and vol. xl. p. 660). He first dipped one of

the thermometers into warm water at 45° C., in such a way that its external metallic envelopment was in contact with the water and took on the temperature of the latter, while at the same time aspiration could proceed undisturbed. When the clock-work was not set in motion and the turbine in the upper part of the instrument was at rest, the thermometer indicated a temperature of 35° C. ; but as soon as aspiration was started by setting the clock-work in motion, the temperature recorded fell to 22°·5 C., being now identical with that indicated by a second thermometer not immersed in water. In the next place, a series of experiments was made in order to determine the rate of flow of the air through the thermometer. To effect this the thermometer was attached by an air-tight joint to the upper end of a glass cylinder whose capacity was 5 litres, whose interior was moistened with soapy water, and whose lower end was closed with a soap-film. On setting the instrument in work the time required for the aspiration of 5 litres of air was measured by the time the soap-film occupied in ascending from the lower to the upper end of the cylinder. The speaker showed that when the turbine was in motion the rate of flow of the aspired air was about 2·5 m. per second ; when in addition to the turbine an external injector was used, the velocity rose to rather more than 3 m. ; when the injector alone was used the velocity was similarly 3 m. The bellows which he had used in his earlier instruments gave a very variable and much slower current of air. Finally, he demonstrated the action of the instrument when employed as a psychrometer. By surrounding the thermometer with gauze and moistening the latter the instrument recorded a temperature of 18° C., while at the same time a similar non-moistened thermometer recorded 21° C. An ordinary psychrometer which was placed in close proximity to the other indicated 21° C. with the dry-bulb, and 16° C. with the wet. The President pointed out that when determining temperatures with an aspiration thermometer the rarefaction of the air must lead to a slight fall of temperature, which is, however, partly compensated for by the friction of the air. Both these factors can be calculated from the known rate of flow of the air.

IN the report of the Berlin Physical Society, NATURE, January 2, p. 215, in the fourth line from the bottom, for "Society" read "Institute."

DIARY OF SOCIETIES.

LONDON.

THURSDAY, JANUARY 9.

ROYAL SOCIETY, at 4.30.—New Experiments on the Question of the Fixation of Free Nitrogen (Preliminary Notice): Sir J. B. Lawes, Bart., F.R.S., and Prof. Gilbert, F.R.S.—On Electric Discharge between Electrodes at Different Temperatures in Air and in High Vacua: Prof. J. A. Fleming.—A Milk-dentition in Orycteropus: Oldfield Thomas.

MATHEMATICAL SOCIETY, at 8.—On the Deformation of an Elastic Shell: Prof. H. Lamb, F.R.S.—On the Relation between the Logical Theory of Classes and the Geometrical Theory of Points: A. B. Kempe, F.R.S.—On the Correlation of Two Spaces, each of Three Dimensions: Dr. Hirst, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

ROYAL INSTITUTION, at 3.—Electricity (adapted to a Juvenile Auditory): Prof. A. W. Rücker, F.R.S.

FRIDAY, JANUARY 10.

ROYAL ASTRONOMICAL SOCIETY, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 7.30.—The Irrigation Works on the Cauvery Delta: Alfred Chatterton.

SATURDAY, JANUARY 11.

ROYAL BOTANIC SOCIETY, at 3.45.

ESSEX FIELD CLUB, at 7.—The Inter-Relations of the Field Naturalist's Knowledge: Prof. J. Logan Lobley.

SUNDAY, JANUARY 12.

SUNDAY LECTURE SOCIETY, at 4.—Heroes of British India; the Men who Conquered, Ruled, and Saved it: Willmott Dixon.

TUESDAY, JANUARY 14.

ZOOLOGICAL SOCIETY, at 8.30.—On a New Species of Otter from the Lower Pliocene of Eppelsheim: R. Lydekker.—A Complete List of the Sphinges and Bombyces known to occur on the Nilgiri Hills of Southern India, with Descriptions of New Species: G. F. Hampson.—On some Cranial and Dental Characters of the Domestic Dog: Prof. Bertram C. A. Windle and John Humphreys.—Fourth Contribution to the Herpetology of the Solomon Islands: G. A. Boulenger.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Recent Dock Extensions at Liverpool: George Fosbery Lyster.

WEDNESDAY, JANUARY 15.

SOCIETY OF ARTS, at 8.

ROYAL METEOROLOGICAL SOCIETY, at 7.15.—Annual General Meeting.—Report of the Council.—Election of Officers and Council.—Atmospheric Dust (illustrated by Lantern Slides): Dr. W. Marcet, F.R.S., President.

ENTOMOLOGICAL SOCIETY, at 7.—Annual Meeting.—Election of the Council and Officers for 1890.—Address by the Right Hon. Lord Walsingham, F.R.S., President.

UNIVERSITY COLLEGE CHEMICAL AND PHYSICAL SOCIETY, at 4.30.—The Magnetization of Iron and Nickel: J. J. Stewart.

THURSDAY, JANUARY 16.

ROYAL SOCIETY, at 4.30.

LINNEAN SOCIETY, at 8.—Life-History of a Remarkable Uredine on Jasminum grandiflora: A. Barclay.—Certain Protective Provisions in some Larval British Teleosteans: E. Prince.

FRIDAY, JANUARY 17.

SOCIETY OF ARTS, at 8.

PHYSICAL SOCIETY, at 5.—On a Carbon Deposit in a Blake Telephone Transmitter: F. B. Hawes.—On Electric Splashes: Prof. S. P. Thompson.—On Galvanometers: Prof. W. E. Ayrton, F.R.S., T. Mather, and W. E. Sumpner.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Food in Health and Disease: Dr. J. Burney Yeo (Cassell).—A Guide for the Electric Testing of Telegraph Cables, 3rd edition: Colonel F. Hoskiœr (Spon).—The Educational Annual, 1890; E. Johnson (Philip).—Parallel Translations of Lines and Surfaces, 2nd edition: D. Maver (Aberdeen, Brown).—Year-book of Pharmacy, 1889 (Churchill).—Naturalistic Photography, 2nd edition: P. H. Emerson (Low).—Warren's Table and Formula Book: Rev. J. Warren (Longmans).—Bergens Museums Aarsberetning for 1888 (Bergen).—Geological Mechanism: J. L. Wilson (J. Heywood).—Bibliography of Meteorology, Part 2, Moisture (Washington).—Proceedings of the Society for Psychical Research, Part 15 (Trübner).—Mind, No. lvii. (Williams and Norgate).

CONTENTS.